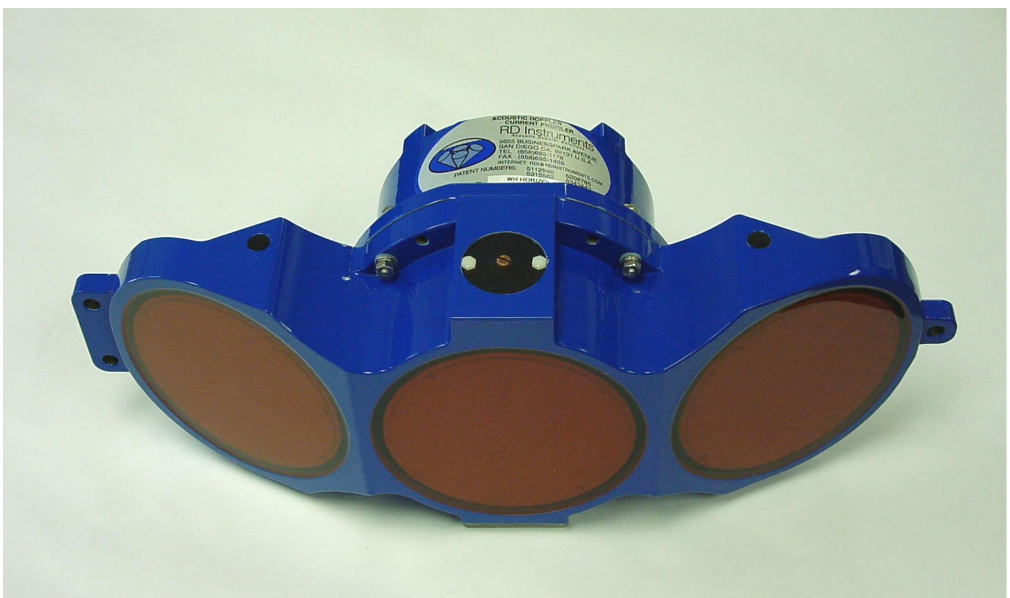
WorkHorse Horizontal ADCP Operation Manual



P/N 957-6212-00 (October 2004)

RD Instruments
Acoustic Doppler Solutions

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WorkHorse H-ADCP Operation Manual

1 Introduction

Thank you for purchasing a RD Instruments (RDI) WorkHorse Horizontal Acoustic Doppler Current Profiler (H-ADCP). This Operation Manual is designed to help H-ADCP users to get familiar with their system.

1.1 Getting Started

You are probably eager to get started, but take a moment to read a few words of guidance. We strongly recommend you read *all* of the provided documentation to learn the full capabilities of your H-ADCP.

The Operation Manual includes the following sections:

- **Introduction**. This section is an overview of the H-ADCP system.
- **Installation**. Use this section to plan your installation requirements. This section includes specifications and dimensions for the H-ADCP (including outline installation drawings).
- **Maintenance**. This section covers H-ADCP maintenance. Use this section to make sure the H-ADCP is ready for a deployment.
- **Test**. Use this section to test the H-ADCP.
- **Troubleshooting**. This section includes a system overview and how to troubleshoot the H-ADCP. If the H-ADCP fails a built-in test or you cannot communicate with the system, use this section to help locate the problem.

The Horizontal Quick Start Guide includes:

- This guide contains information on how to use the H-ADCP hardware and software.

The Commands and Output Data Format Guide includes:

- This guide contains a reference for all commands and output data formats used by the H-ADCP. Use the *Command Quick Reference Card* to help remember the direct commands used by the H-ADCP.

The Documentation CD includes:

- The Documentation CD has Adobe Acrobat® Portable Document File (pdf) versions of all the user documentation. Use the electronic documentation to quickly search for information.

> **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.rdinstrument.com). Please check our web site often.

1.2 Conventions Used in Manuals

Conventions used in the H-ADCP Operation Manual have been established to help you learn how to use the H-ADCP quickly and easily.

Windows menu items are printed in bold: **File** menu, **Collect Data**. Items that need to be typed by the user or keys to press will be shown as **<F1>.** If a key combination were joined with a plus sign (**<ALT+F>**), you would press and hold the first key while you press the second key. Words printed in italics include program names (*BBTalk*) and file names (*default.txt*).

Code or sample files are printed using a fixed font. Here is an example:

```
WorkHorse Broadband ADCP
RD INSTRUMENTS (c) 1997-2004
ALL RIGHTS RESERVED
Firmware Version 16.xx
>
```

You will find two other visual aids that help you: Notes and Cautions.

> **NOTE.** This paragraph format indicates additional information that may help you avoid problems or that should be considered in using the described features.

> **CAUTION.** This paragraph format warns the reader of hazardous procedures (for example, activities that may cause loss of data or damage to the H-ADCP).

1.3 WorkHorse H-ADCP Care

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

1.3.1 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 underwater-connect cable and dummy plug when disconnecting them. **Failure to do so will break the retainer strap.**
- Do not apply any upward force on the housing connector as the I/O cable is being disconnected. **Stressing the connector may cause the ADCP to flood.** Read the Maintenance section 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 H-ADCP 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 H-ADCP if it will be exposed to sunlight.
- Do not store the ADCP in temperatures over 60 degrees C. **The urethane faces may be damaged.**
- Vent the system before opening by loosing the hardware on the housing. **If the ADCP flooded, there may be gas under pressure inside the housing.**
- 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 H-ADCP by the external I/O cable. **The connector or cable will break.**

1.3.2 Assembly Guidelines

- Read the Maintenance section for details on H-ADCP re-assembly. Make sure the housing assembly O-ring stays in the groove when you re-assemble the H-ADCP. Tighten the hardware as specified. **Loose, missing, stripped hardware, or a damaged O-ring can cause the H-ADCP transducer to flood.**
- Place a light amount of DC-111 lubricant on the 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. When you connect the cable with power applied, you may see a small spark. **The connector pins may become pitted and worn.**
- The **H-ADCP** I/O cable is *wet* mate-able, not *under water* mate-able.

1.3.3 Deployment Guidelines

- Read the Quick Start Guide and the Software User's Guides. **These guides have tutorials to help you learn how to use the ADCP.**
- Align the compass whenever the recorder module is replaced, or when any ferrous metals are relocated inside or around the H-ADCP 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 H-ADCP. **Ferro-magnetic materials affect the compass.**

1.4 System Overview

The H-ADCP is designed to measure real-time horizontal current profiles from a permanent fixed mount. The H-ADCP system consists of an H-ADCP transducer with Standard Profiling modes, cables, and software. The input power requirements for the H-ADCP are +20 to 60 VDC. The H-ADCP system requires the addition of a Windows® compatible computer to collect data.

The transducer assembly contains the transducer ceramics and electronics. Standard acoustic frequencies are 600kHz, and 300kHz. See the outline drawing for dimensions and weights.

I/O Cable Connector – Input/Output (I/O) cable connects the H-ADCP to the computer.

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

Housing– The standard housing allows deployment depths to 200M

Thermistor – The Thermistor measures the water temperature.

Pressure Sensor (depth)- The optional pressure sensor measures water pressure.

Transducer Head – The electronics and transducer ceramics are mounted to the transducer head

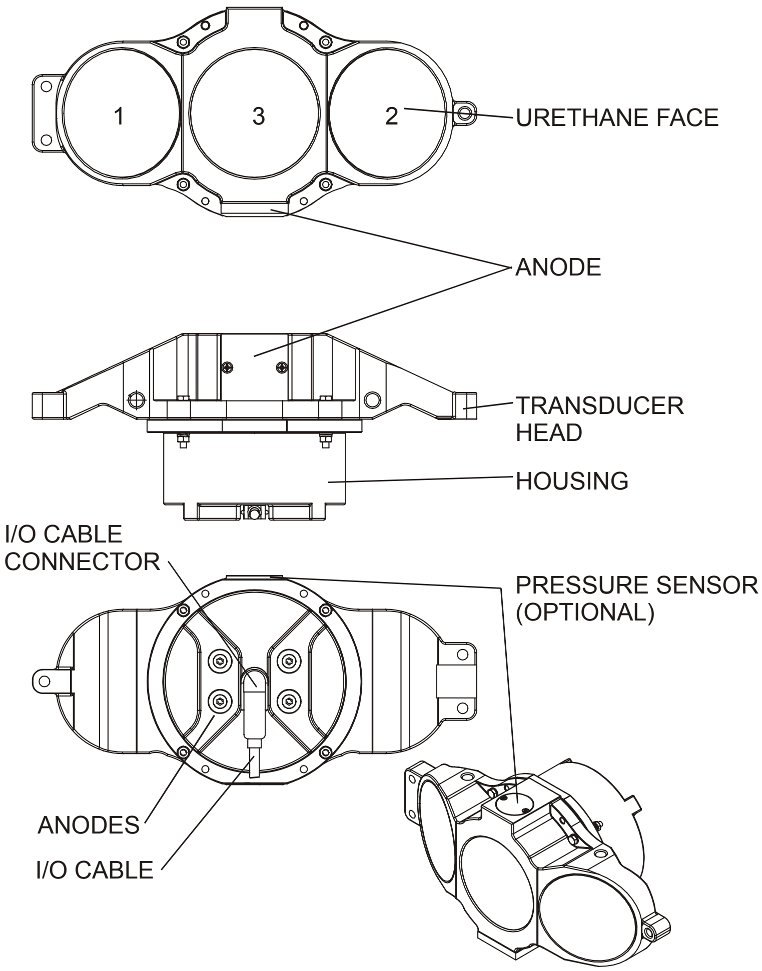


Figure 1. Horizontal ADCP Overview

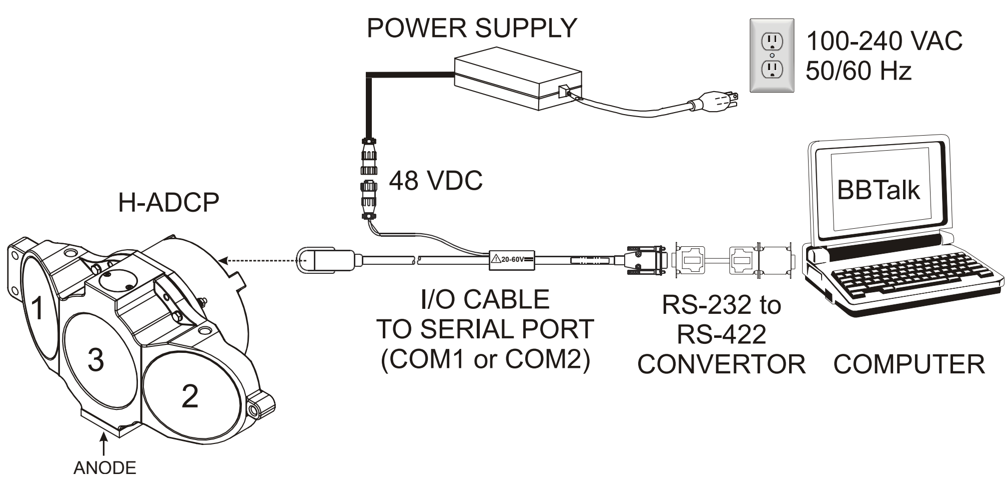


Figure 2. H-ADCP Connections

2 Installation

The H-ADCP must be rigidly mounted to a structure, such as a large vessel, solid wall, pier, or pile. The mounting structure must be firm, stable, without settlement or displacement over time.

In order to gain the maximum profiling range at a site, we recommend the H-ADCP be mounted near the middle of the water depth at the mounting structure location. For a site with a significant seasonal change of water level, the H-ADCP may need to be mounted at different elevations according to seasonal water level change. In deep water we recommend the H-ADCP be mounted 5 to 20 meters below the surface.

2.1 H-ADCP Orientation

The H-ADCP must be mounted with its transducer orientation in the horizontal direction. That is, the three transducers, which are for water velocity measurement, must be looking horizontally (also called side-looking). The pressure sensor, which is for water depth measurement, must be looking up towards the water surface.

- ***X-Axis*** - Pitch is measured around the X-axis and should be set to zero.
- ***Y-Axis*** - Roll is measured around the Y- axis and should be set to zero.
- ***Pressure Sensor*** – The pressure sensor must be facing up towards the water surface

2.2 Attach H-ADCP to Structure

Attach the H-ADCP to a rigid structure, solid wall, pier, or pile. The mounting structure must be firm, stable, without settlement or displacement over time.

Double-check all of the connections, seals, and bolts. Connect the I/O cable and make sure that the strain relief is attached to the cable.

Bolt the H-ADCP to the structure. Make sure that the I/O cable is routed so that it is not subject to becoming entangled or snagged.

NOTE. The mounting hardware used to attach the H-ADCP to the structure is not provided by RD Instruments.

A diver may be needed to mount the H-ADCP.

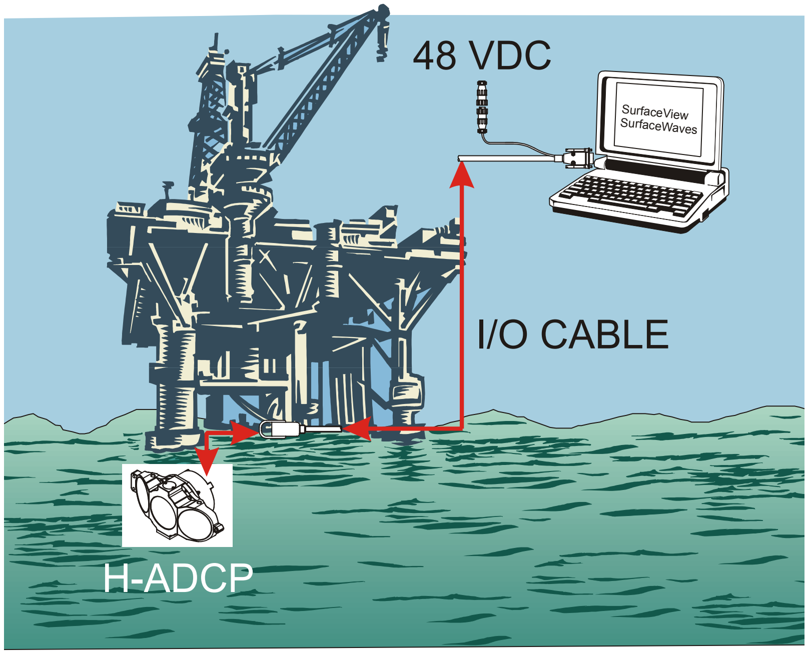


Figure 3. Installing the H-ADCP

2.3 Testing the Installed H-ADCP

Once the H-ADCP is mounted in the water, it's time to communicate with it and make adjustments. *SurfaceView* will be used to adjust the pitch and roll settings as well as to check for abnormalities in the acoustic backscattering intensity pro-file.

a. Start *SurfaceView*.

b. On the **Setup Wizard**, click **Real-Time**. Click **Next**.

c. Once communications is established, on the **Communications Settings** screen, click **Next**.

d. Accept the default setting on the next several screens. Click **Finish**.

Pitch and Roll Adjustment

The deployment screen of the *SurfaceView* software indicates the pitch and roll angles of the H-ADCP.

- Adjust the mount until the roll is zero. The H-ADCP rolls about the Y-axis. **The roll must be zero**.
- Adjust the mount until the pitch is zero. The H-ADCP pitches about the X-axis.

NOTE. A slight upward or downward pitch may be required to avoid beam interference from the bottom or surface.

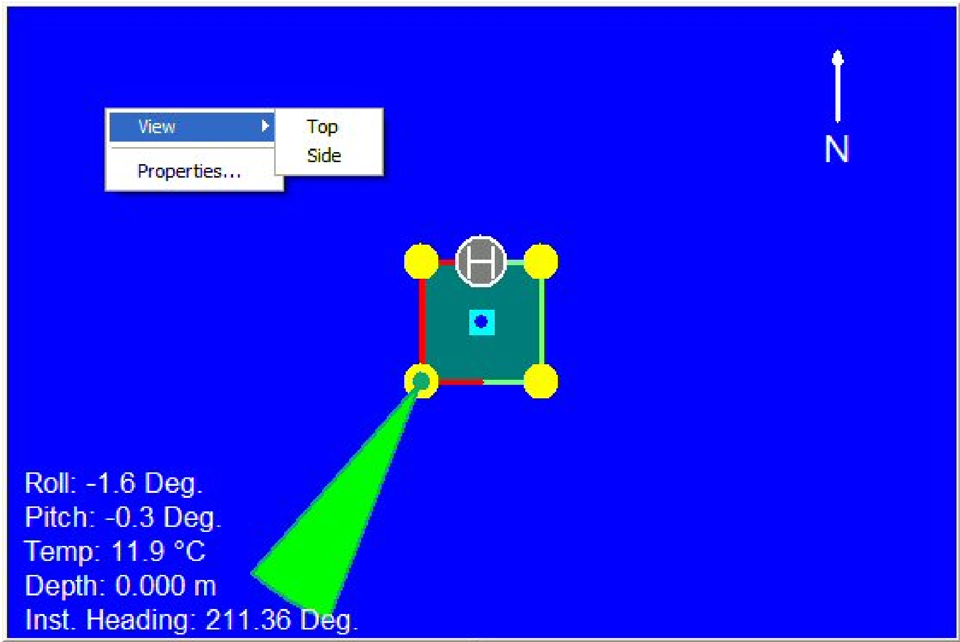


Figure 4. *SurfaceView* Deployment Screen

Intensity Plot

Start collecting data and check the intensity profile for abnormal data. What you are looking for are unusually large spikes, especially ones that stay fixed along the Y-axis of the plot.

- Spikes that don't move are usually fixed objects in the water like rocks or pylons. Spikes that move along the Y-axis are usually moving objects like schools of fish or logs.
- It is important to mount the H-ADCP in a location free from fixed obstructions. The velocity data will be questionable if the intensity profile shows abnormalities.

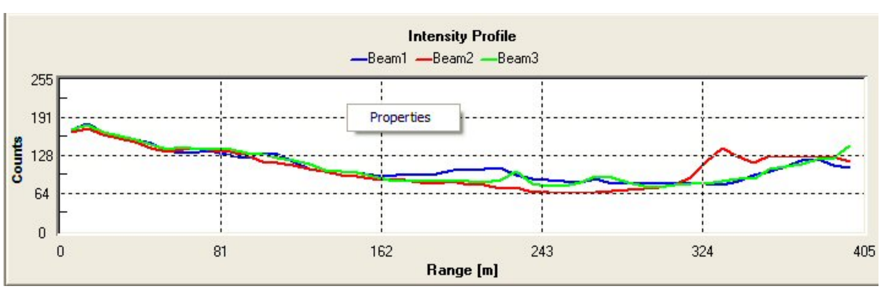


Figure 5. *SurfaceView* Intensity Profile

2.4 Periodic Maintenance

The Maintenance section explains routine maintenance procedures. You rarely need access to the electronics inside the transducer head. However, one external maintenance item is important enough to mention here as it may affect how you install the transducer head.

Objects deployed within about 100 meters (328 feet) of the surface are subject to the buildup of organic sea life (biofouling). Soft-bodied organisms usually cause no problems, but hard barnacle shells can cut through the urethane transducer face causing transducer failure and leakage into the ADCP (see Figure 6).

Figure 6. Barnacle Damage to Urethane Face

The best-known way to control biofouling is cleaning the ADCP transducer faces often. However, in many cases this is not possible. The other alternatives include the use of a window or some sort of anti-foulant protection.

Some of our users have had success applying a thin coat (≈4 mm; ≈0.16 in.) of either a 50:50 mix of chili powder and Vaseline 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.

Some organizations may decide to use antifouling grease. However, most antifouling greases are toxic and may cause problems. Recent tests suggest antifouling grease may cause the urethane on the transducer faces to develop cracks. Warmer temperatures accelerate this effect.

The other method is to use antifoulant paint. At present, we recommend the following antifouling paint manufacturer and paint brand: Courtalds Finishes Interlux brand paints, US Telephone: 908-686-1300, Web Page: www.interlux.com.

CAUTION.

1. Read the Material Safety Date Sheet before using any of the listed solvents and paints.
2. Some antifouling coatings may not be legal for use in all areas. Check with your local environmental agency before using the antifouling paint.
3. Do not arbitrarily use antifouling paints. Be aware that antifouling paints can accelerate the dezincification corrosion of brass. Once initiated, dezincificatioin will rapidly destroy the brass.
4. RDI no longer recommends the use of Nopcocide for the prevention of biofouling. If using antifouling grease, remove it immediately after recovering the ADCP.
5. 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.
6. When possible, do not coat the transducer faces with cuprous oxide or related paints that contain chemicals such as copper, chrome, or arsenic. These paints advance the corrosion of the transducer assembly and will cause the urethane to separate from the transducer cups.
7. All US 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.

2.5 Cabling Considerations

The Input/Output (I/O) cable connects the H-ADCP to the computer. RD Instruments delivers the cable with both connectors attached. The transducer-end connector is molded on, so you can use it below the waterline. The cable is custom-made in lengths specified by the user.

Use care when routing this cable through bulkheads, deck plates, cable runs, and watertight spaces. Make allowances in cable length and engineering design plans for cable routing. When necessary, use strain reliefs on the cables. Route the cable so:

- You can install it with the connectors attached.
- It does not have kinks or sharp bends.
- You can easily replace it if it fails.

2.6 Computer Considerations

We designed the H-ADCP to use a Windows® compatible computer. The computer controls the H-ADCP and displays its data, usually through our *SurfaceView* and *SurfaceWaves* programs. Table 1 lists the minimum computer requirements.

NOTE. It is highly recommended that you download and install all of the critical updates, recommended updates, and the service releases for the version of Windows® that you are using prior to installing any RDI software.

Table 1: Minimum Computer Hardware Requirements

Windows® XP, Windows® 2000, Windows® NT 4.0 with Service Pack 4 installed, Windows® 98, or Windows® 95
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 Comport (two or more High Speed UART Serial Comports recommended)
Minimum display resolution of 800 x 600, 256 color (1280 x 760 High Color recommended)

The computer configuration varies depending of the number of communication ports and the external data refresh rate. Serial communications require a lot of processor resources, and the minimum requirements can vary. A good quality video card is required to operate *SurfaceView* and *SurfaceWaves* simultaneously. We do not use graphic card 3D functions, however, video memory is needed to display all graphics.

However, with experience we can recommend that:

- If you are using more than two communication ports, you should not use a Celeron processor.
- Intel Pentium III processors work best to operate the ADCP and give access to the display and keyboard without losing ensembles.

2.7 Power Considerations

Standard H-ADCPs require +20 to 60 VDC to operate. Transmitted power increases or decreases depending on the input voltage (within the voltage range of 20 to 60 VDC).

NOTE. The transmitted power is decreased 1 DB if the input voltage drops from 42 VDC to 33 VDC. For a 300kHz H-ADCP, each DB will result in a decrease in range of one default depth cell.

2.8 12 VDC Power Considerations

Some special-order H-ADCPs require a DC supply between 10.5 volts and 18 volts. Either an external DC power supply or battery can provide this power. If you are using a battery, use the largest rated amp-hour battery as possible. A car battery should last one to two days powering a 600-kHz H-ADCP.

3 Maintenance

This section explains how to prepare the H-ADCP for deployment, how to do certain maintenance, repair, and equipment modification procedures, and how to prepare the H-ADCP for storage or shipment.

"Spare Parts," page 41 lists the items in the tools and spares parts kits. Use these kits when doing routine H-ADCP maintenance.

> **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.rdinstrument.com). Please check our web site often.

3.1 I/O Cable and Dummy Plug

The underwater connector (on the housing) and the I/O cable and dummy plug are molded wet-mate connectors. The 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 H-ADCP is in storage or is being handled.

3.1.1 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 H-ADCP 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 connector. This may cause several serious problems: a) The connector or connector pins can crack. b) The O-ring on the bottom of the connector can be damaged. c) The molded urethane on the connector may separate from the brass insert. **If the 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 housing (see Figure 7, page 15). Your thumb should rest on top of the connector or against the edge of the housing. *Do not try to fit your hand under the cable as it passes over the housing*. This is what causes the upward force!

c. Pull the cable straight out away from the housing with a gentle rocking motion. Do not apply any upward force on the connector as it is being disconnected.

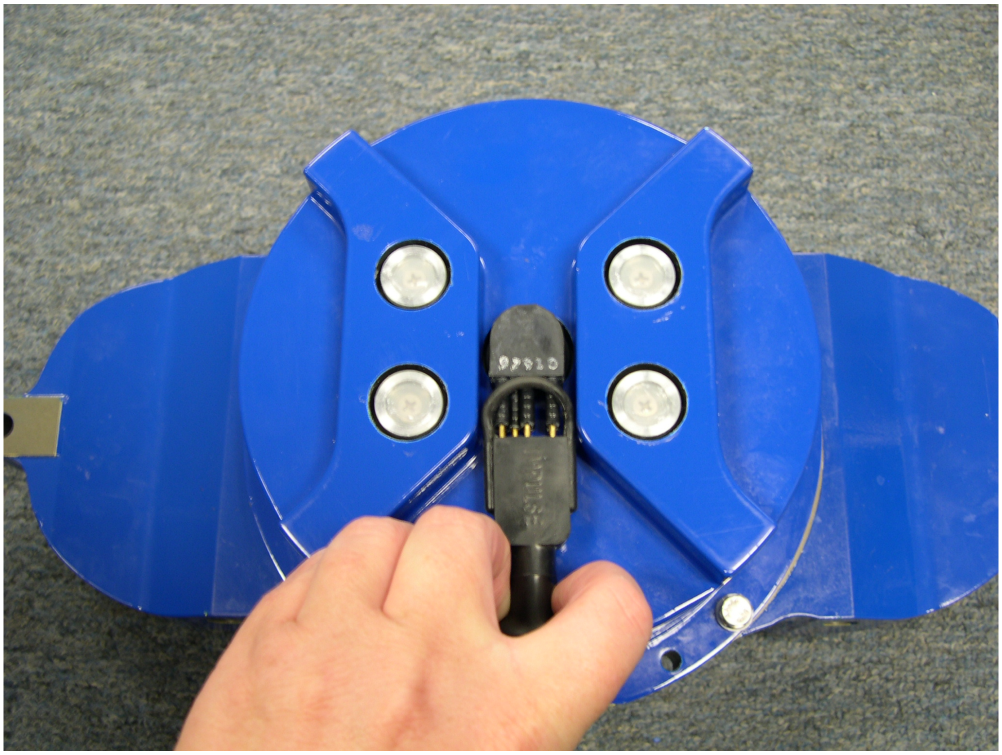


Figure 7. Removing the I/O Cable

3.1.2 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 H-ADCP 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 connector. This may cause several serious problems: a) The connector or connector pins can crack. b) The O-ring on the bottom of the connector can be damaged. c) The molded urethane on the connector may separate from the brass insert. **If the 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 connector pins. This will help seat the connector.

b. Gently push the cable straight in toward the connector. Do not apply any upward force on the connector as it is being connected.

c. Roll the retaining strap over the connector.

3.2 H-ADCP Disassembly

This section explains how to remove and replace the housing to gain access to the H-ADCP's electronics, batteries, and internal recorder. Read all instructions before doing the required actions.

3.2.1 Housing Removal Procedures

To remove the housing, do the following steps.

a. Dry the outside of the H-ADCP.

b. Stand the H-ADCP on its transducer face on a soft pad.

c. Remove all power to the H-ADCP.

d. Remove the I/O cable and place the dummy plug on the I/O cable connector (see "I/O Cable and Dummy Plug," page 14).

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

e. Loosen (do not remove) the four housing bolts to vent the system.

f. Once all four housing bolts (6-mm) have been loosened, remove the bolts from the housing.

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

g. Carefully pull the housing away from the transducer until you can gain access to the connector jack on the common mode choke. Use care; the plastic mating surfaces scratch easily. Do not damage the mating surfaces.

h. Squeeze the sides of the internal I/O cable connector to release it from the common mode choke jack. Set the housing aside.

i. Clean the O-ring mating surfaces with a soft, lint-free cloth. Inspect the surfaces for damage (see "O-ring Inspection and Replacement," page 17). Even small scratches can cause leakage around the O-ring seal.

3.3 H-ADCP Re-assembly

To replace the housing, proceed as follows.

a. If you are sealing the H-ADCP for a deployment, be sure you have done all appropriate maintenance items (see "Sealing the H-ADCP for a Deployment," page 28).

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 H-ADCP (see "Desiccant Bags," page 28).

3.3.1 O-ring Inspection and Replacement

This section explains how to inspect/replace the H-ADCP 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

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

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 matter, and flow marks. The O-ring must be smooth and uniform in appearance. Defects must be less then 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 matter, 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. If a scratch is on the plastic housing flange O-ring groove, it may be gently sanded using 600-grit (wet) sandpaper. Use care not to cause further damage.

d. Lubricate the O-ring with a thin coat of DC-111 lubricant (see "Spare Parts," page 41). 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 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.

3.3.2 Housing Replacement

a. Stand the H-ADCP 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 17). 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 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 internal I/O connector to the plug on the common mode choke.

d. Place the housing on the transducer, aligning the mating holes and with the I/O cable connector pins facing toward the anode on the transducer. When mating the housing with the transducer flange, try to apply equal pressure to all parts of the O-rings. Make sure the face O-ring remains in its retaining groove.

CAUTION. Check that no wires or any other object is pinched between the housing and the transducer. 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.**

e. Examine the housing assembly nuts, bolts, and washers (6-mm) for corrosion; replace if necessary. Figure 8, page 19 shows the assembly order of the mounting hardware. All the hardware items are needed to seal the H-ADCP properly.

f. Install all four sets of hardware until “finger-tight.”

g. 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-ring as you tighten the bolts. If one bolt is tightened more then the others, the O-ring can become pinched or torn. **A damaged O-ring will cause the system to flood.**

CAUTION. Do not over tighten the bolts that hold the transducer and housing together. If you tighten too far, you can crack or break the housing. 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 housing 6-mm bolts is 5.6 Newton-meters (50 pound-inches).

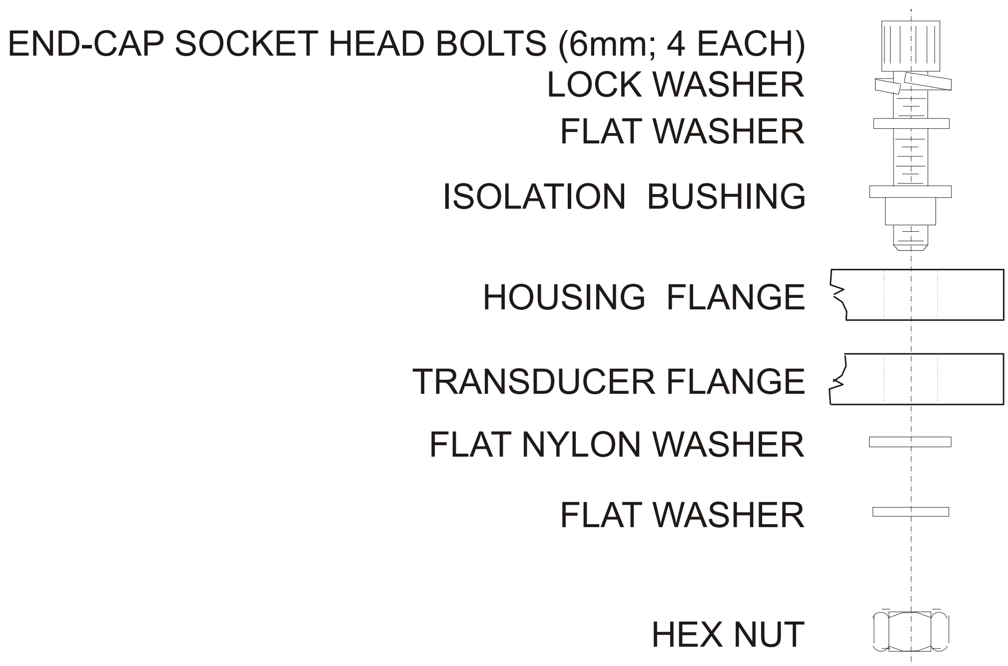


Figure 8. Housing Mounting Hardware

3.4 Zinc Anode Inspection and Replacement

H-ADCP systems have five sacrificial zinc anodes. If the H-ADCP does not have exposed bare metal, properly installed anodes help protect the H-ADCP from corrosion while deployed. Read all instructions before doing the required actions.

3.4.1 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 and housing 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.

c. If you have doubts about the condition of the anodes, remove and replace the anode.

3.4.2 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.

Housing Anodes. 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.

Transducer Anode. Remove the housing. Measure the resistance between the anode and any one of the four screws holding the PC boards to the transducer. The resistance should be less than five ohms.

3.4.3 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 H-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.

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 electrical continuity. 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.

3.5 Compass Calibration

The compass calibration algorithm corrects for the distortions caused by the local magnetic fields to give you an accurate measurement. You should be aware of the following items:

- We recommend against calibrating the H-ADCP while on a ship. 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 H-ADCP inside the fixture. Depending on the strength and complexity of the fixture's field, the calibration procedure may be able to correct it.

3.5.1 Preparing for Calibration

a. Place the H-ADCP on a piece of strong cardboard on top of a smooth wooden (non-magnetic) table. If a wooden table is not available, place the unit on the floor as far away from metal objects as possible. Use the cardboard to rotate the H-ADCP during calibration—this way you will not scratch the H-ADCP.

b. Connect the H-ADCP as shown in the Quick Start Guide.

c. Start *BBTalk*. See the RDI Tools User's Guide for assistance on using *BBTalk*.

3.5.2 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 5º of rotation for a full 360º rotation. When it has collected data for all required directions, the H-ADCP 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 H-ADCP housing.

a. Prepare the H-ADCP for calibration (see "Preparing for Calibration," page 22).

b. Using *BBTalk,* send a Break to wake up the H-ADCP.

c. At the > prompt, type **AX** and press return.

d. When prompted, rotate the H-ADCP smoothly and slowly 360 degrees (approximately 5 degrees per second). Pay particular attention to the Overall Error. For example;

```
>AX

↓

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).

3.5.3 Compass Calibration Procedure

The built-in automated compass calibration procedure is similar to the alignment verification. The H-ADCP uses the first rotation(s) to compute a new calibration matrix and the final rotation 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. There are three compass calibrations to choose from; one only corrects for hard iron while the other two correct 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.

For the H-ADCP that is normally in a fixed horizontal attitude we use option "c" of the AF command that corrects for both hard and soft iron characteristics in a single plane.

a. Start *BBTalk*. Send a Break to wake up the H-ADCP.

b. At the > prompt, type **AF** and press return. When the calibration procedure starts, choose the calibration type "c".

c. Choose option "a" to start the calibration procedure. When prompted, rotate the H-ADCP slowly 360 degrees (approximately 5 degrees per second).

d. If the calibration procedure is successful, it records the new calibration matrix to nonvolatile memory. The H-ADCP will not change its matrix unless the calibration is properly carried out.

e. If the calibration procedure is not successful, return your H-ADCP 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.

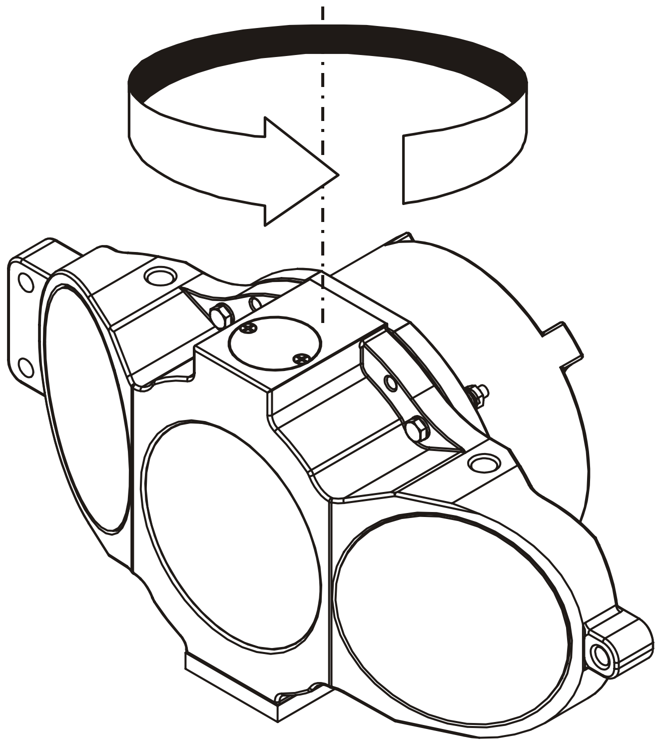


Figure 9. Compass Alignment

3.6 Fuse Replacement

There is one fuse located on the PIO Board (see Figure 28, page 70) that protects the H-ADCP 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 housing.

c. The PIO board fuse is located next to the internal I/O connector. 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. Check the fuse using an ohmmeter. Replace the fuse if necessary with the correct voltage and amperage fuse (see "Spare Parts," page 41).

f. Install the housing.

g. Test the system.

3.7 Communications Setting

A switch on the PIO board (see Figure 10) changes the communication settings between RS-232 and RS-422. Your computer and the H-ADCP must both be set to the same communication setting. Use the RS-232-to-RS-422 converter if the H-ADCP is using RS-422 communications and you computer only has an RS-232 COM port.

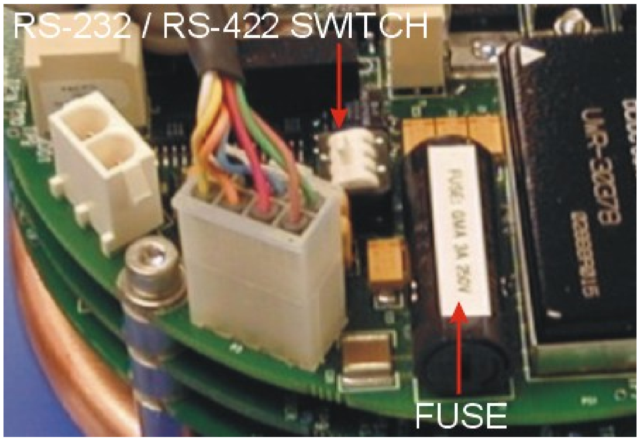


Figure 10. Communication Switch and Fuse

3.8 Firmware Upgrades

The firmware for H-ADCP ADCPs in located on flash RAM chips on the CPU board. Firmware must be downloaded. Use the following procedure to download firmware to the H-ADCP.

a. Connect the H-ADCP to the computer as shown in the Quick Start 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 "Testing the H-ADCP," page 42).

3.9 Feature Upgrades

The feature upgrade installation program is used to install upgrades in a H-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. At this time, there are no upgrades available for the H-ADCP systems.

a. Set up the H-ADCP as shown in the Quick Start 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 11). The program is encoded with the ADCP's serial number and the requested feature upgrade.

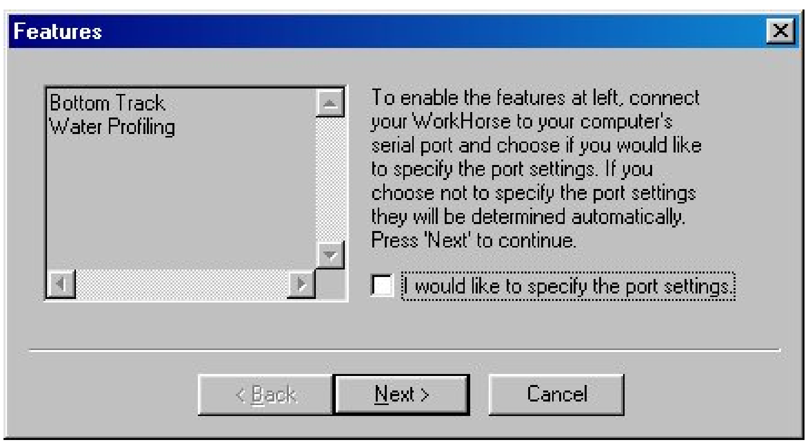


Figure 11. Installing Feature Upgrades

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.

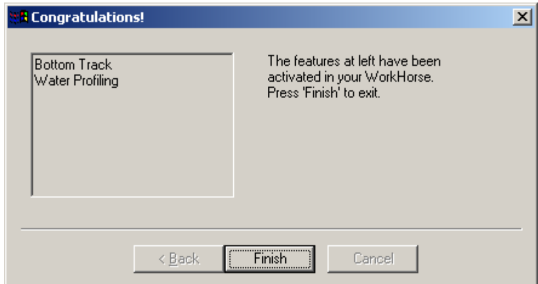


Figure 12. Feature Upgrade Completed

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

3.10 PC Card Recorder

The PC Card recorder is located on the Digital Signal Processor (DSP) board inside the H-ADCP's electronics (see Figure 13). To recover data, the card can be removed and used in a personal computer (PC), or left in the H-ADCP, and accessed by using *WinSC* (see the *WinSC* User's Guide). To remove or install a PC card, do the following.

NOTE. Memory cards are not included with H-ADCPs. Two PCMCIA memory cards slots are available, with the total memory capacity not to exceed 1GB.

a. Turn off power to the H-ADCP.

b. Remove the housing (see "Housing Removal Procedures," page 16).

c. Remove the PC cards by pushing the button on the side of the PCMCIA card slot. 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. PC cards slide easily in or out when properly oriented.

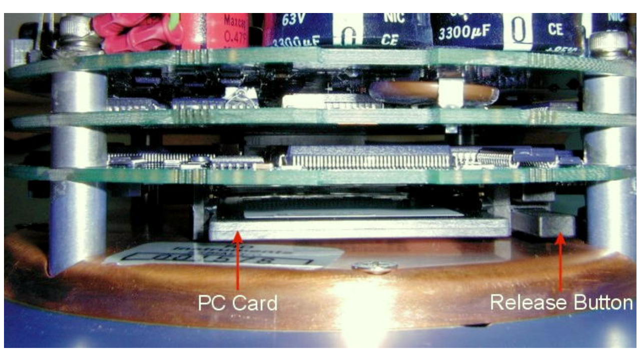


Figure 13. PC Card Recorder

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 Replacement,” page 18).

> **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 H-ADCP. Other cards may work but we have not had any success.

3.11 Desiccant Bags

Desiccant bags are used to dehumidify the housing interior. Desiccant is essential in deployments with plastic housings. The factory-supplied desiccant lasts a year at specified H-ADCP 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 ((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 (see “Spare Parts,” page 41) whenever you are preparing to deploy or store the H-ADCP 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 housing.

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 (see “Spare Parts,” page 41) between the PIO board and the housing.

d. Install the housing (see “Housing Replacement,” page 18).

3.12 Sealing the H-ADCP for a Deployment

Use following steps to seal the H-ADCP for a deployment.

a. Check the H-ADCP electronics; there should be no loose screws or missing hardware.

b. Install the PC card(s) if used

c. Add two fresh desiccant bags inside the H-ADCP housing (see "Desiccant Bags," page 28).

d. Install the housing (see "Housing Replacement," page 18).

e. The H-ADCP is now ready for deployment unless you want to take steps to prevent biofouling (see "Prevention of Biofouling," page 30).

f. Use the Quick Start Guide to connect the H-ADCP system. See "Testing the H-ADCP," page 42 to test the H-ADCP before the deployment.

3.13 Protective Coating Inspection and Repair

RDI uses paint on the housing for identification and corrosion protection. For more protection, the housing and the transducer assembly are first anodized. Do not damage the surface coatings when handling the H-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 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 H-ADCP 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 H-ADCP to RDI for repair.

   1. Clean and prepare the damaged area using a fine-grade abrasive cloth or a fine-grade abrasive silicon carbide 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

3.14 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.

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 H-ADCP (see Figure 14, page 31).

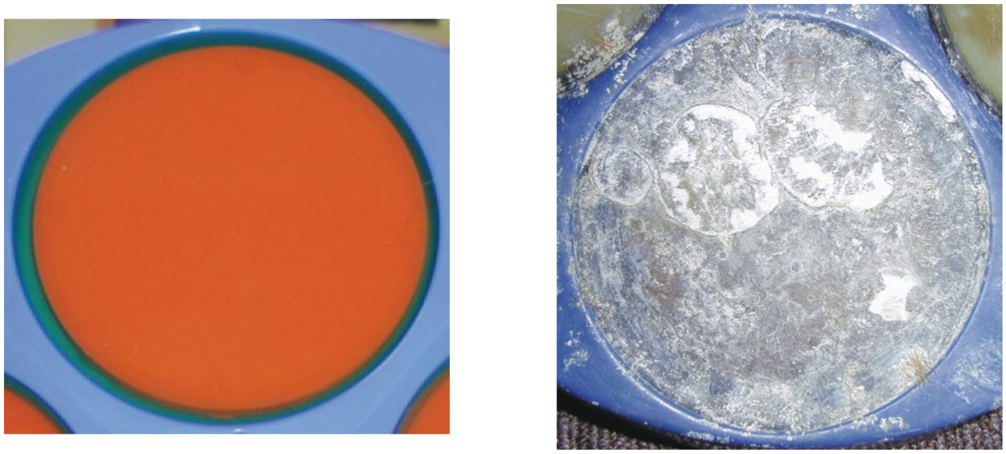
In shallow-water applications, the use of antifouling grease may be appropriate if you cannot clean the transducer faces often (weekly), and if the antifouling grease meets all of your local safety and environmental laws.

3.14.1 Controlling Biofouling

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

- Coat the entire H-ADCP 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 14. Barnacle Damage

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

If using antifouling grease, remove the grease immediately after recovering the H-ADCP 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 H-ADCP regularly (weekly). If using antifouling grease, remove it immediately after recovering the H-ADCP.
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.

3.14.2 Recommended Antifouling Paints

The plastic H-ADCP housing simplifies anti-fouling paint application. 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

3.14.3 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 H-ADCP 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 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 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.

Transducer Faces (urethane surfaces)

a. Preparation - Lightly sand by hand with 120-grit paper.

b. Application - Apply one or two coats of Trilux-2 at four 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.

Metal Surfaces (Housing)

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 four 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.

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

Figure 15. Antifouling Paint Applied to a WorkHorse Sentinel

3.15 Pressure Sensor

The Pressure sensor is optional and by default the pressure sensor is not enabled. To enable the pressure sensor you must use the EZ command and set Bit 2 to 1, i.e. EZ1111101 (Default is EZ1011101).

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

a. Connect and apply power to the system as described in the Quick Start Guide.

b. Start *BBTalk* and wakeup the H-ADCP (press the **END** key).

c. Type **AZ** and press the **Return** key.

d. Exit *BBTalk*.

3.15.1 Pressure Sensor Maintenance

In order to read the water pressure, water must be able to flow through the copper screw on the pressure sensor. The tiny hole in the copper screw may at times be blocked. Use the following procedure to clean the screw.

NOTE. The pressure sensor is optional. It may not be included on your system.

a. Place the ADCP on its' side, pressure sensor facing upward. Use a soft pad to protect the ADCP.

b. Use a straight-slot screwdriver to remove the copper screw.

c. Gently clean out the hole in the copper screw with a needle. If the hole becomes enlarged or the screw is corroded, replace the screw. A replacement copper screw is included in the spare parts kit (part number 817-1067-00).

d. Install the copper screw. Tighten the screw "finger tight" (0.226 N-m, 2 lbf-in). Do not over tighten the screw or you may strip the threads on the plastic cover disc. If this happens, return the ADCP to RDI for repair.

CAUTION.

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

Do not remove the cover disc or 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.

3.15.2 Pressure Sensor Cavity Oil Fill

The pressure sensor cavity needs to be filled with oil before deployment to deal with both trapped air and long-term reliability of the pressure sensor. The oil to be used is Dow Corning Q7-9120 Silicone fluid, 12,500 CST. This fluid is supplied with the H-ADCP in the spare parts kit. The filling of the cavity can be completed any time before system installation however care should be taken to keep the H-ADCP from high temperature during this time.

NOTE. The pressure sensor cavity is not filled with oil when shipped. This must be done before deploying the H-ADCP.

Use the following procedure and Figure 16, page 35 to fill the pressure sensor with oil.

a. Place the H-ADCP on its side with the vertical beam facing down and the pressure sensor port facing up. Use a soft pad to protect the H-ADCP.

b. Use a straight-slot screwdriver to remove the copper port screw on the pressure sensor. Do not remove the pressure sensor cover.

c. A plastic bottle with silicone oil (part number 75BK6004-00) is included in the spare parts kit. Place the tip of the bottle over the screw hole. Ensure the plastic bottle tip is not inserted into the screw hole. Slowly administer the oil into the cavity through the hole. Allow time for the air to escape as you fill. Once the oil level is up into the port screw hole, then stop filling.

d. Install the copper port screw slowly, allowing time for the oil to pass through the port screw orifice. Tighten the screw "finger tight" (0.226 N-m, 2 lbf-in). Do not over tighten the screw or you may strip the threads on the plastic cover disc. If this happens, return the H-ADCP to RDI for repair.

> **NOTE.** The Pressure sensor cavity should be checked and if needed refilled between deployments. Only remove the copper port screw for this inspection and re-fill.

Figure 16. Filling the Pressure Sensor Cavity with Oil

3.16 Storage and Shipping Maintenance

This section lists the maintenance items to do before storing the H-ADCP. These maintenance items include:

- Removing biofouling (see "Removal of Biofouling," page 36).
- Inspecting the transducer head (see "Transducer Head Inspection," page 36).
- Preparing the H-ADCP for final storage or shipping (see "Final Storage or Shipping Preparation," page 37).

3.16.1 Removal of Biofouling

Before storing or shipping the H-ADCP, 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.

CAUTION. Always dry the H-ADCP before placing it in the storage case to avoid fungus or mold growth. Do not store the H-ADCP in wet or damp locations.

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 H-ADCP 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 H-ADCP with fresh water to remove all residues. If barnacles have entered more than 1.0 to 1.5 mm (0.06 in.) into the transducer face urethane, you should send the H-ADCP to RDI for repair (see Figure 14, page 31). If you do not think you can remove barnacles without damaging the transducer faces, contact RDI.

3.16.2 Transducer Head Inspection

The urethane coating on the transducer faces is important to H-ADCP 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.

3.16.3 Final Storage or Shipping Preparation

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

⚠	**CAUTION.** If you are shipping a H-ADCP 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 H-ADCP 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 H-ADCP.

If you need to ship or store the H-ADCP, use the original shipping crate whenever possible. If the original packaging material is unavailable or unserviceable, 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 handing.

e. In any correspondence, refer to the H-ADCP by model and serial number.

CAUTION. Always dry the H-ADCP before placing it in the storage case to avoid fungus or mold growth. Do not store the H-ADCP in wet or damp locations.

3.17 Returning H-ADCPs to RDI for Service

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

3.17.1 Domestic Shipments

Step 1 - Get a Return Material Authorization

The best way to make sure RDI is aware of your intentions to ship equipment is to obtain a Return Material Authorization (RMA) before sending the shipment. Return Material 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 Material 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 Material Authorization is issued, we will tell you the RMA number. Please include this number on all packages and correspondence.

Step 2 - Ship via air freight, prepaid

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. In addition, 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. (RMA 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

3.17.2 International Shipments

Step 1 - Get a Return Material Authorization

The best way to make sure RDI is aware of your intentions to ship equipment is to obtain a Return Material Authorization (RMA) before sending the shipment. Return Material 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 Material 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 Material Authorization is issued, we will tell you the RMA number. Please include this number on all packages and correspondence.

Step 2 - Ship Via Air Freight, Prepaid

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. (RMA Number)**
5 Avenue Hector Pintus
06610 La Gaude, France

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
Phone: +33(0) 492-110-930
Fax: +33(0) 492-110-931

- 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

3.18 Spare Parts

Table 2: H-ADCP Spare Parts

Item #	Part #	Description
1.	2-260	O-Ring, Face Seal, Duro 70 EPDM
2.	717-3008-00	Jumper, GND, Main Electronics
3.	817-1067-00	Screw, Pressure Sensor, H-ADCP
4.	817-3003-00	Washer, Felt H-ADCP Electronics
5.	DC-111	Lubricant, Silicone1, 5.3oz Tube
6.	DES3	Desiccant, Sealed Bag
7.	GMA-3A	Fuse, 5mm X 20mm 3A 250V
8.	M6WASHSPLTI	Washer, 6mm Split Lock
9.	M6WASHSTDTI	Washer, Flat, 12.5mm OD
10.	M6X1.0NUTTI	Nut, Hex, 10mm
11.	M6X1.0X45HHTI	Screw, Hex Head,
12.	M8WASHSPLTI	Washer, Split Lock
13.	M8WASHSTDTI	Washer, Flat, 12.5mm OD
14.	M8X1.25NUTTI	Nut, Hex, 13mm
15.	M8X1.25X65HHTI	Screw, Hex Head,
16.	75BK6004-00	Kit, fill, silicone oil
17.	817-1067-00	Copper screw
18.	817-1086-00	Anode, transducer
19.	810-4006-00	Anode, housing

4 Testing the H-ADCP

Before deploying the H-ADCP, it is a good idea to make sure that it is working properly. This simple test checks that the H-ADCP is able to communicate with the computer.

a. Start the *BBTalk* program (for help on using *BBTalk*, see the RDI Tools User's Guide).

b. On the **Connect To** screen, select **WorkHorse**.

c. Select the COM port the H-ADCP cable is connected to.

d. Click **Next**.

e. Enter the **Baud Rate**, **Parity**, **Stop Bits**, and **Flow Control**. If you are unsure of the settings, leave them at the default settings.

f. Click **Next**, than **Finish**.

g. On the **File** menu, click **Break** (you can also press the **End** key to send a break or use the Toolbar and press the blue **B** button).

h. You should see the wakeup message appear on the log file window.

If the wakeup message is not readable, on the **File** menu, click **Properties**. Click the **Auto Detect ADCP** button. Click **OK** when the H-ADCP is detected. Try to wakeup the H-ADCP again.

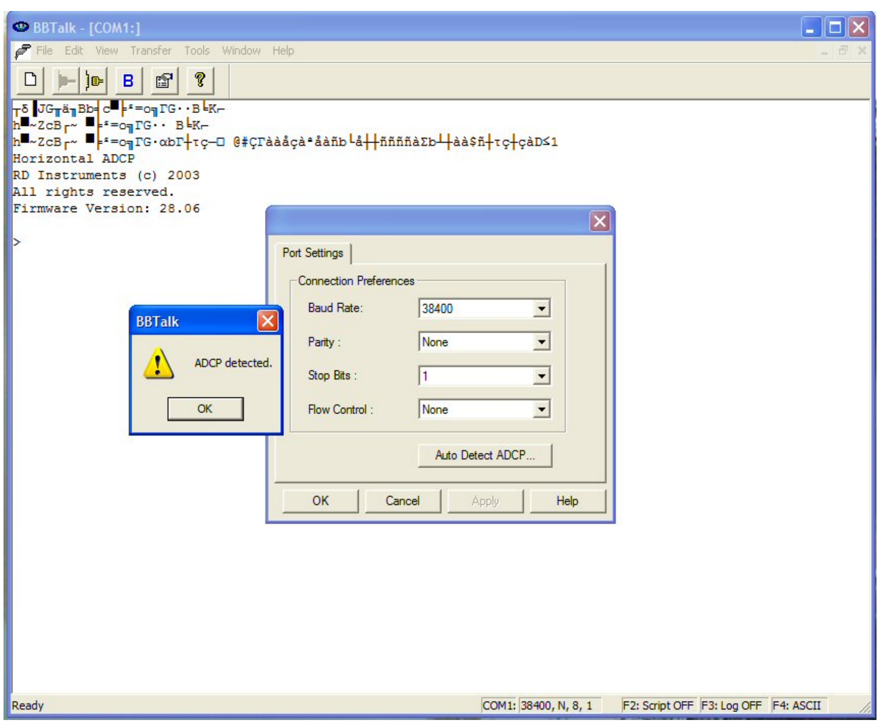


Figure 17. Testing the H-ADCP

i. At the ">" prompt in the communication window, enter the direct command **CR1** then press the Enter key. This will set the H-ADCP to the factory default settings.

j. At the ">" prompt in the communication window, enter the direct command **CK** then press the Enter key. This will save the factory default setting as the default power up condition.

k. At the ">" prompt in the communication window, enter the direct command **PS0** then press the Enter key. This will display the H-ADCP system con-figuration data.

```
>cr1
[Parameters set to FACTORY defaults]

>ck
[Parameters saved as USER defaults]

>ps0
   Serial Number:  0
       Frequency:  614400 Hz
   Configuration:  HADCP: 2-beam velocity + vertical stage.
 Transducer Type:  PISTON
      Beam Angle:  20 Degrees
    Beam Pattern:  CONVEX
    CPU Firmware:  28.06
    FPGA Version:  1.00.026
         Sensors:  TEMP  PRESS  TILTS
 Sensor Firmware:  33.00 f
```

l. At the ">" prompt in the communication window, enter the direct command **PA** then press the Enter key. This will run the H-ADCP Pre-deployment tests.

```
>PA
RAM test..........PASS
ROM test..........PASS
GO
>
```

m. At the ">" prompt in the communication window, enter the direct command **PT3** then press the Enter key. This will run the H-ADCP Receive Path test.

```
>PT3
Receive Path Test (Hard Limited):
        H-Gain W-BW        L-Gain W-BW        H-Gain N-BW        L-Gain N-BW
Correlation Magnitude (percent)
Lag Bm1 Bm2 Bm3 Bm4    Bm1 Bm2 Bm3 Bm4    Bm1 Bm2 Bm3 Bm4    Bm1 Bm2 Bm3 Bm4
  0 100 100 100 100    100 100 100 100    100 100 100 100    100 100 100 100
  1  85  86  87  88     83  80  79  90     80  82  82  95     78  77  81  93
  2  51  58  61  73     52  44  44  69     43  47  49  81     39  41  48  78
  3  25  35  36  54     25  19  23  46     19  22  24  65     15  16  25  63
  4   6  18  19  39      8   7  14  27      9  10   8  48      7   3  14  47
  5   9  12  12  27      8   3   7  10      6   8   4  32      6   3   9  32
  6  11   6   8  15     11   3   6   5      6   9   5  20      8   3   7  20
  7   9   5   7   7      9   4   6  12      4  11   4  13      7   2   5  13
Sin Duty Cycle (percent)
     45  52  48  60     52  48  52  49     40  49  42  65     52  52  50  60
Cos Duty Cycle (percent)
     50  50  50  49     51  49  47  52     51  48  51  59     54  46  52  58
RSSI Noise Floor (counts)
     42  40  66  68     29  27  58  58     52  52  73  77     28  27  57  57

>
```

5 Troubleshooting

Considering the complexity of the H-ADCP, we have provided as much information as practical for field repair; *fault location to the component level is beyond the scope of these instructions*. The provided information assumes that faults are isolated with a large degree of certainty to a Least Replaceable Assembly (LRA) level only. The time to repair the system will be minimized if an entire replacement unit is available in the field. If time to repair is of essence, RD Instruments strongly advises the availability of the listed LRAs.

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.rdinstrument.com). Please check our web site often.

Table 3: List of Least Replaceable Assemblies

LRA	Description
ADCP	The entire ADCP; includes the electronics, housing, and transducer ceramic assemblies.
I/O Cable	Connects the ADCP with the Computer.
Housing	Includes the housing, connector, and internal I/O cable.
ADCP electronics	The spare boards kit Includes the PIO, CPU, and DSP boards.
PC Card	Replaceable PC recorder card.

Since these Least Replaceable Assemblies are manufactured in different configurations, please contact RD Instruments (see “Technical Support,” page 59 for contact information) to obtain the correct part number for your specific system configuration. When contacting RD Instruments about a replacement assembly, please provide the serial numbers of the H-ADCP. If you want to replace the I/O Cable only, then please provide the cable length.

5.1 Equipment Required

Special test equipment is not needed for trouble shooting and fault isolation. The required equipment is listed in Table 4, page 45. Any equipment satisfying the critical specification listed may be used.

Table 4: Required Test Equipment

Required Test Equipment	Critical Specification
DMM	Resolution: 3 ½ digit
	DC-Voltage Range: 200 mV, 2V, 20 V, 200V
	DC-Voltage Accuracy: ± 1%
	AC-Voltage Range: 200 V, 450 V
	AC-Voltage Accuracy: ± 2%
	Resistance Range: 200, 2 k, 20 k, 200 k, 20 MOhm
	Res.-Accuracy: ± 2% @ 200 Ohm to 200 kOhm
	Res.-Accuracy: ± 5% @ 20 Mohm
	Capacitance Range: 20 nF, 2 uF, 20 uF
	Capacitance Accuracy: ± 5%
Serial Data EIA Break-Out Box such as from International Data Sciences, Inc. 475 Jefferson Boulevard Warwick, RI 02886-1317 USA.	Model 60 or similar is recommended as it eases the troubleshooting of RS-232 communication problems significantly. Other manufacturers or models may be substituted.

NOTE. The EIA Break-out Panel is not necessary, but eases RS-232 communication problems troubleshooting significantly.

5.2 Basic Steps in Troubleshooting

The first step in troubleshooting is determining what type of failure is occurring. There are four types of failures:

- Communication failure
- Built-In test failure
- Beam failure
- Sensor failure

Communication failures can be the hardest problem to solve as the problem can be in any part of the system (i.e. the computer, H-ADCP, cable, or power). The symptoms include having the system not respond, or not responding in a recognizable manner (for example "garbled" text).

Built-In test failures will appear when the system diagnostics are run. Use *WinSC* or *BBTalk* to identify the failing test.

Beam failures can be identified when collecting data or during the user-interactive performance tests.

Sensor failures can also be identified when collecting data or during the user-interactive performance tests. The sensor may send incorrect data, or not be identified by the system.

5.3 Troubleshooting the H-ADCP

Although the H-ADCP is designed for maximum reliability, it is possible for a fault to occur. This section explains how to troubleshoot and fault isolate problems to the Least Replaceable Assembly level (see Table 3, page 44). Before troubleshooting, review the procedures, figures, and tables in this section. Also, read the "Functional Description of H-ADCP Operation," page 62 to understand how the H-ADCP processes data.

> **CAUTION.** Under all circumstances, follow the safety rules listed in the "Troubleshooting Safety," page 46.

5.3.1 Troubleshooting Safety

Follow all safety rules while troubleshooting.

> **CAUTION.** Servicing instructions are for use by service-trained personnel. To avoid dangerous electric shock, do not perform any service unless qualified to do so.

> **CAUTION.** Complete the ground path. **The power cord and the outlet used must have functional grounds.** Before power is supplied to the H-ADCP, the protective earth terminal of the instrument must be connected to the protective conductor of the power cord. The power plug must only be inserted in a socket outlet provided with a protective earth contact. The protective action must not be negated by the use of an extension cord (power cable) without a protective conductor (grounding). Grounding one conductor of a two-conductor outlet is not sufficient protection.

> **CAUTION.** Any interruption of the earthing (grounding) conductor, inside or outside the instrument, or disconnecting the protective earth terminal will cause a potential shock hazard that could result in personal injury.

> **CAUTION.** Only fuses with the required rated current, voltage, and specified type must be used. Do not repair fuses or short circuit fuse-holders. To do so could cause a shock or fire hazard.

> **CAUTION.** Do not install substitute parts or perform any unauthorized modifications to the instrument.

> **CAUTION.** Measurements described in the manual are performed with power supplied to the instrument while protective covers are removed. Energy available at many points may, if contacted, result in personal injury.

CAUTION. Do not attempt to open or service the power supply.

CAUTION. Any maintenance and repair of the opened instrument under voltage should be avoided as much as possible, and when inevitable, should be carried out only by a skilled person who is aware of the hazard involved.

CAUTION. Capacitors inside the instrument may still be charged even if the instrument has been disconnected from its source of supply.

5.3.2 Troubleshooting a Communication Failure

H-ADCPs communicate by means of two serial communication channels. The user can choose between RS-232 and RS-422 classes of serial interfaces with a switch on the PIO board in the H-ADCP.

To successfully communicate, both the host computer and the H-ADCP must communicate using the same class of serial interface. Standard serial interfaces in IBM compatible computers are also RS-232.

NOTE. If you have just received your H-ADCP from RDI, the standard configuration is RS-232.

NOTE. If you are using a high baud rate and/or a long I/O cable (greater then 50 meters) connected to a H-ADCP, RS-232 may not work. Switch to RS-422 and try to wakeup the H-ADCP again.

There are two types of communication failures; nothing happens at all when attempting to wake up the H-ADCP, or something happens, but not the correct wake up message is displayed.

Incorrect Wakeup Message

When you send a break and the data is garbled, you may have a baud rate or parity mismatch between the H-ADCP and the computer, or the H-ADCP may be set for RS-422 instead of RS-232. Check the RS-232/422 switch on the PIO card inside the H-ADCP. See "Incorrect Wakeup Messages," page 48 for symptoms of garbled wakeup messages.

NOTE. Most communication problems are associated with incorrect cabling (i.e. the serial cable is connected to the wrong port) or data protocols (i.e. the wrong baud rate is set between the H-ADCP and computer).

Nothing Happens

If you cannot talk to the H-ADCP (i.e., no wakeup message at all), you need to isolate the problem to a computer fault, power, cable failure, Deck Box (Mariner only), or a H-ADCP problem. Check the following items:

a. Connect the H-ADCP to a computer as shown in the Quick Start Guide. Check that all cable connections are tight.

b. Is the H-ADCP AC power working? Is the input voltage between 100 to 240 VAC? Is the output level 48 VDC?

c. If the H-ADCP is running from a battery, check that the battery voltage is above 30 Volts DC. H-ADCPs will work at 20 volts; however, both lithium and alkaline battery packs with voltages below 30 volts are at or near their end of life, and are approaching uselessness.

d. Is the computer hooked up properly? Does it have power?

e. Make sure that your computer and the *BBTalk* programs are set up to use the communication port the serial cable is connected to on the computer.

5.3.3 Incorrect Wakeup Messages

The following conditions may indicate a communications mismatch or lost boot code.

- Sending a break causes “garbage” to appear on the screen. The “garbage” text may keep scrolling. This happens when the computer is using RS-232 and the H-ADCP is set for RS-422 or vice-versa. Check the RS-232/RS-422 switch on the PIO board (see “Communications Setting,” page 25).
- Sending a break causes “garbage” to appear on the screen. You can hear the H-ADCP “beep” when the break is sent. The “garbage” text does not keep scrolling. Check that the H-ADCP and computer are both using the same baud rate. See the CB-command in the Command and Output Data Format guide.
- If the H-ADCP gives a steady “beep” when power is applied, the “>” prompt appears on the screen, and a “X” appears when additional breaks are sent, this may indicate that the boot code has been lost (see “Firmware Upgrades,” page 25). This can happen if you abort while downloading new firmware. Try downloading the firmware again.

5.3.4 Check the Power

The following test can be done with a voltmeter to check the power.

Check the power going into the H-ADCP by measuring the voltage on the end of the cable that connects to the H-ADCP at Pins 3 and 7 (GND) (see Figure 26, page 68). The voltage should be +48 VDC (using the standard AC adapter). If not, check the voltage at the other end of the cable and the AC adapter.

5.3.5 Check the I/O Cable

This test will check the communication between the computer and H-ADCP.

a. Disconnect both ends of the cable and measure the continuity using a DMM (see Figure 22, page 60 for the wiring diagram). Correct any problems found.

n. Reconnect the I/O cable to host computer.

a. Load *BBTalk* on your computer. Select the proper communications port (see the RDI Tools User's Guide for help on using *BBTalk*).

b. For RS-232 communications, short pins 1 and 2 together on the female 7-pin connector that was plugged into the H-ADCP (see Figure 23, page 61). If you are using RS-422, connect a jumper between pin 2 to pin 6 and another jumper between pins 1 to pin 5 of the underwater connector at the H-ADCP end of the cable.

c. Type any characters on the keyboard. The keys you type should be echoed on the screen. If you see characters, but not correctly (garbage), the cable may be too long for the baud rate. Try a lower baud rate. If this works disconnect the jumper on pins 1 and 2 and then push any keys on the keyboard. You should NOT see anything you type.

d. If the keys are echoed correctly on the screen, the computer and the communication cable are good. Re-connect the I/O cable to the H-ADCP. The above loop-back test does not show if transmit and receive pairs are interchanged. Thus, it is important that you check the wiring diagrams provided in "H-ADCP Cables," page 60.

> **NOTE.** A loop-back test does not show if transmit and receive wires or pairs are interchanged, even though characters may be displayed correctly.

5.3.6 H-ADCP Checks

Once you have eliminated possible problems with the power, I/O cable, communications settings, and the computer, that leaves the H-ADCP as the source of the problem. The following checks may help in some situations.

Cold Start the H-ADCP

a. Remove the housing to gain access to the PC boards.

b. Remove *all* power to the H-ADCP.

> **CAUTION.** Disconnect the power cables P1 and P2 on the PIO board to ensure that NO POWER is applied to the H-ADCP during the next step.

c. Short TP10 to TP11 on the PIO board for 10 seconds.

d. Remove the jumper.

e. Connect the computer and connect power to the H-ADCP. Send a break to the H-ADCP. This should start the H-ADCP in the "cold start" mode.

Fuse

Check the fuse on the PIO board is not blown (see "Fuse Replacement," page 24).

> **CAUTION.** Only fuses with the required rated current, voltage, and specified type must be used. Do not repair fuses or short circuit fuse-holders. To do so could cause a shock or fire hazard.

Boot Code Error

If the H-ADCP gives a steady "beep" when power is applied, the ">" prompt appears on the screen, and a "X" appears when additional breaks are sent, this may indicate that the boot code has been lost. This can happen if you abort while downloading new firmware. Try downloading the firmware again.

5.4 Troubleshooting a Built-In Test Failure

The built-in diagnostic tests check the major H-ADCP modules and signal paths. The spare boards kit may be used to repair some failures. This kit includes:

- Spare Boards including PIO board, CPU board, and DSP board. These boards are held together with the standard M4 screw assembly and kept inside a protective anti-static bag.
- A disk containing your original beam cosine matrix table
- Tools for installation

5.4.1 When to use the Spare Boards Kit

Use this Kit whenever you have any of the following problems:

- Cannot communicate to the H-ADCP and you have ensured that the serial port on the computer, H-ADCP Cable, Deck Box (Mariner only), and H-ADCP RS-232 to RS-422 converter (if applicable) are all working properly.
- Your H-ADCP fails any of the following PA tests at any time:

CPU Tests:

- RTC
- RAM
- ROM

DSP Tests:

- Timing RAM
- Demod RAM
- Demod REG
- FIFOs

System Tests:

- XILINK Interrupts
- Receive Loop Back Test

- Your H-ADCP fails any of the following PA tests provided the items indicated by {} have been checked:

Recorder Tests:

Any recorder tests fails {provided that the PCMCIA card(s) have been checked for proper installation, operation and they are DOS formatted; we STRONGLY recommend checking PCMCIA cards in a computer before replacing the boards}

System Tests:

Transmit {if the H-ADCP fails when it is in water and air bubbles have been rubbed from the faces}

Sensor Tests:

H/W Operation {if the H-ADCP fails when it is NOT sitting/resting on its side, or located near a large magnetic field like a motor in a boat}

The spare boards kit will not correct any of the following failures:

- A damaged beam or its urethane surface
- Damage to the transducer beam connections below the copper shield
- If it passes all PA tests and yet the data is all marked as bad
- Fails the following PA test:

System Tests:

Wide Bandwidth {bandwidth tests may fail due to external interference}

Narrow Bandwidth {bandwidth tests may fail due to external interference}

RSSI Filter

Transmit

Table 5: Pre-deployment Test (PA) Possible Cause of Failures

PA Test Name	Possible Cause of Failure
Pre-Deployment Tests CPU Tests: RTC RAM ROM	CPU board failed
Recorder Tests: PC Card #0 Card Detect Communication DOS Structure Sector Test (short) PC Card #1 Card Detect Communication DOS Structure Sector Test (short)	PC card not plugged in PC card failed DSP board failed
DSP Tests: Timing RAM Demod RAM Demod REG FIFOs	DSP board failed
System Tests: XILINX Interrupts	DSP or CPU board failed
Receive Loop-Back	DSP or CPU board failed
Wide Bandwidth	Not in water External interference DSP or Receiver board failed
Narrow Bandwidth	
RSSI Filter	
Transmit	Not in water or PIO board failed
Sensor Tests: H/W Operation	PIO board failed Receiver board failed Pressure sensor failed H-ADCP laying on its' side

5.4.2 Installation of the Spare Board Kit

This Kit has been setup so that you will replace all three of the H-ADCP boards at once. This is done so that you do not have to risk damaging the individual boards while swapping in individual boards. The heading, pitch, and roll sensors have all been calibrated (the temperature sensor is an independent calibration and not changed by these new boards). Once you have replaced your original boards place them back in the Spare Board Kit box and contact RD Instruments Customer Service Department so that you can return them for repair.

CAUTION. Before handling either the Spare Board Kit or the original Board Set, always wear an earth-grounding static protection strap. The electronics in the H-ADCP are very sensitive to static discharge. Static discharge can cause damage that will not be seen immediately and will result in early failure of electronic components.

We assume that a qualified technician or equivalent will perform all of the following work.

The Spare Boards Set will allow your system to perform to the same velocity specifications as your original set. There is, however, an offset error in the compass that can be as great as ±1.5 degrees. This error CANNOT be removed by doing the Field Calibration procedure (AF command) even though you MUST do this as part of the installation. The additional ±1.5 degrees can only be removed by RDI at the factory.

However, in most cases, the total compass error will still be within our original specification of ±5.0 degrees. The only way to be sure that you have smaller errors than this specification is to perform your own local compass verification and correct any errors you find during your post processing of the data.

5.4.3 Remove the Original Set of Boards

a. Remove the housing assembly.

b. With your earth-ground static protection strap on, use a 3mm Allen wrench, to remove the four bolts that secure the three original H-ADCP boards to the Transducer assembly.

c. Note the orientation of the transmit cable connector as it is plugged into the PIO board and to the Receiver board (see Figure 18).

   This cable must be removed and it has a very tight fit. To remove this cable, lift straight up on the three boards and tilt slightly (no more than 2 cm) toward the cable. This should allow you enough slack to unplug the cable from the PIO board. If this is not possible you may unplug the cable from the Receiver board. Be sure to note its orientation before unplugging.

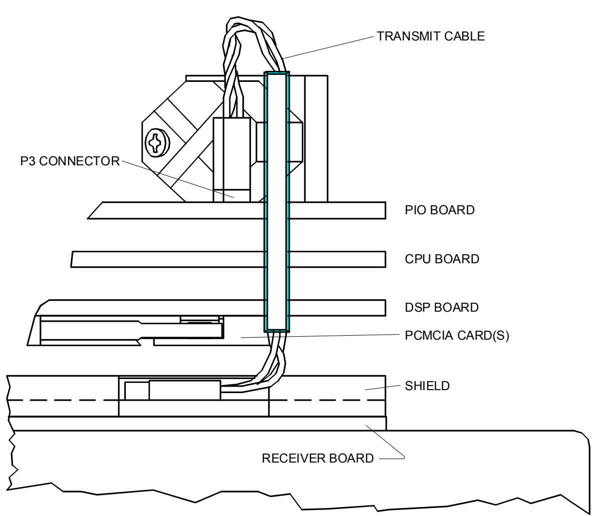


Figure 18. Transmit Cable

d. Once the transmit cable has been disconnected you may now remove the top three boards as a set by lifting the set straight up.

These top three boards are connected to each other via connectors and will remain as one piece (see Figure 19). The DSP board connects to the Receiver board through a 26-pin header. The 26-pin header is a series of male pins. The 26-pin header may or may not stay connected to the DSP board when you remove the top three boards. If you see that there are male pins sticking out of the DSP board when you finish removing the board set then the header has remained attached to the DSP board. If this happens remove it and place it into the Receiver board. To remove it, gently rock it back and forth while pulling it away from the DSP board. Once removed, align it with the connector on the Receiver board and press it into place.

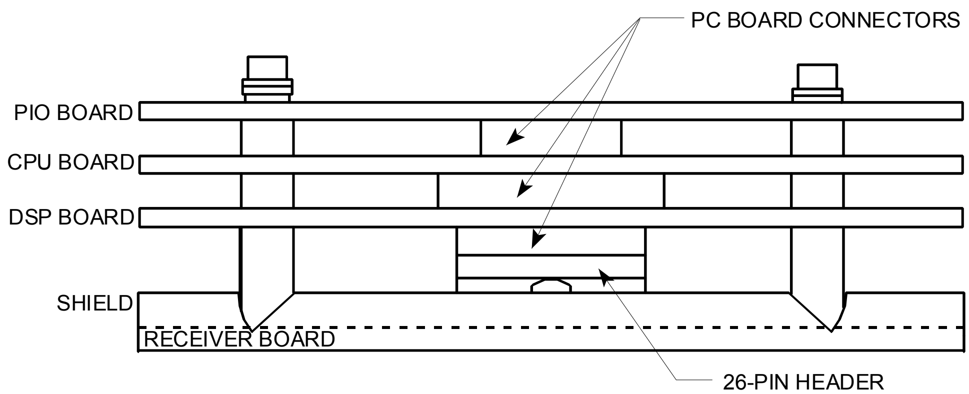


Figure 19. PC Board Connectors

e. Remove all PCMCIA card(s) from the original set of boards. These PCMCIA cards will be used again once you install your Spare Boards Set. The Spare Board set does NOT contain a PCMCIA card(s). The PCMCIA card(s) are located on the bottom of the DSP board. To remove the PCMCIA card(s) press the button(s) on the side of the PCMCIA card slot. As you press this button the PCMCIA card will slide out. You will have to pull the card(s) out the rest of the way once the button is depressed all the way in.

f. Set the original board set to the side for now.

5.4.4 Installing the Spare Board Kit

a. With your earth-ground static protection strap on, remove the Spare Board Kit from the anti-static bag.

b. Using a 3 mm Allen wrench and a 7mm wrench remove the nuts from the bolts that secure the Spare Boards together. You will be using these bolts to secure the spare set in your system. DO NOT change the position of any of the bolts. The bolt containing the felt washers and ground jumper must remain in the same position (see Figure 20).

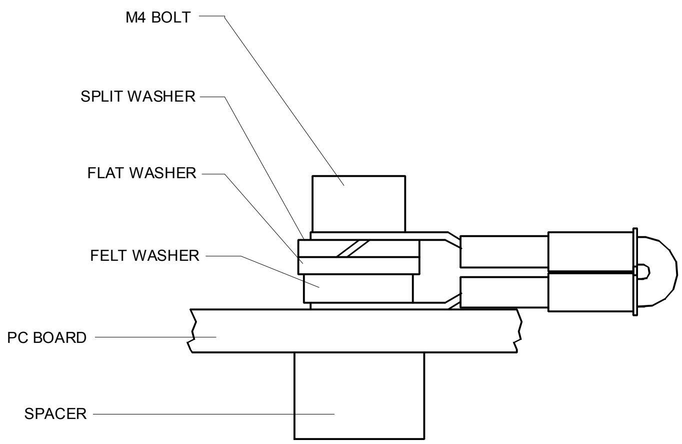


Figure 20. Ground Jumper

c. Place the nuts (just removed) on the four bolts of your original set of boards and place them into the anti-static bag. You will use the new set of bolts included in the Spare Board kit to secure them to the Transducer assembly.

d. Install all PCMCIA cards removed in "Remove the Original Set of Boards," page 53 step e into the PCMCIA card slots. The PCMCIA card is keyed and will only connect when it has been aligned correctly and slid all the way in. The PCMCIA card is installed with the label side pointing away from the DSP board.

e. Connect the Spare Board set to the Receiver board. Align the Spare Board set to the 26-pin header connected to the Receiver board. As you connect the Spare Board set, connect the transmit cable you removed in "Remove the Original Set of Boards," page 53 step c. Be sure to connect the cable in the same orientation as was installed on the original board set.

   To test that the transmit cable is connected properly, start *BBTalk* and run the PT4 test. The test failure example shown below is what you would see for a missing or improperly attached transmit cable.

```
[BREAK Wakeup A]
H-ADCP Broadband ADCP Version 16.21
RD Instruments (c) 1996-2002
All Rights Reserved.
>pt4

IXMT    =      0.0 Amps rms  [Data= 0h]
VXMT    =     19.3 Volts rms [Data=4ch]
   Z    =    999.9 Ohms
Transmit Test Results = $C0 ... FAIL
>
```

f. Insert the four new bolts and tighten to 4 Newton-pounds.

g. Install the housing.

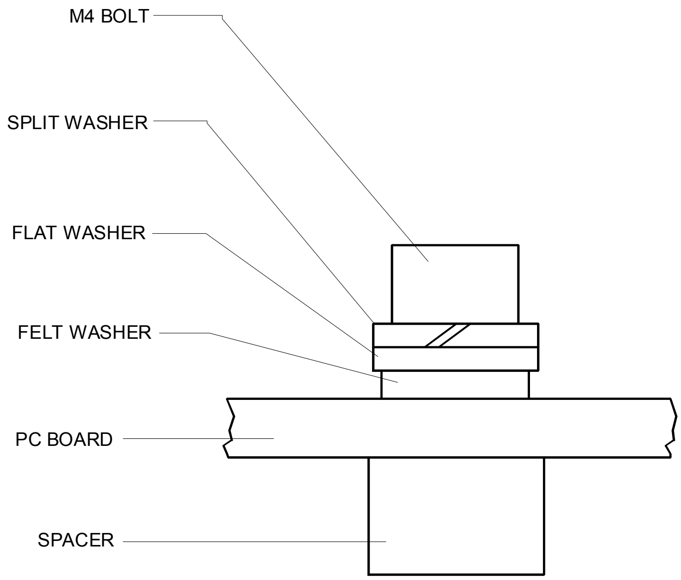


Figure 21. Mounting Hardware

5.4.5 Installing the Beam Cosine Matrix

The beam cosine matrix table corrects small transducer beam misalignment angles that occur during manufacturing.

a. Connect your H-ADCP as you would normally and apply power.

b. Start *BBTalk* and confirm that the H-ADCP is communicating normally and which communication port you are using (COM 1 or COM 2).

c. Place the Beam Cosine Matrix Disk into your computer's disk drive.

d. If your H-ADCP is connected to COM 1, press **<F2>** and run the script file *xxxx_1.scr* (where xxxx is your system serial number).

   If your H-ADCP is connected to COM 2, press **<F2>** and run the script file *xxxx_2.scr* (where xxxx is your system serial number).

   Your Beam Cosine Matrix table will automatically be updated in your H-ADCP and a file called SPRBD.LOG will be created. You can view the contents of this file to confirm that the data entered during the &V portion matches the contents in the PS3 results under the label Q14.

5.4.6 Testing the System

a. Install the housing.

b. Connect the cable and power as you normally do and test as H-ADCP as shown in "Testing the H-ADCP," page 42. All PA tests should pass when run in water and the PC tests should pass out of water.

c. ***Perform a field calibration of your compass*.** Use the "Compass Calibration," page 22 for instructions on running the AF command. Remember that there will be up to 1.5 degrees of offset error in the compass measurement. This error is not removed by the field calibration.

You have completed the H-ADCP Spare Board Installation. The original boards can be returned to RDI for repair. Please contact the RD Instruments Customer Service Department for return shipping instructions and repair costs at:

- EMAIL: rdifs@rdinstruments.com
- PHONE: 858-693-1178
- FAX: 858-578-4016

5.5 Troubleshooting a Beam Failure

If the beam continuity test fails, a bad DSP board, Receiver board, PIO board, or a bad beam may cause the failure. If replacing the DSP and PIO board (included with the spare boards kit) does not fix the problem, the H-ADCP must be returned to RDI for repair.

```
>PC1

BEAM CONTINUITY TEST

When prompted to do so, vigorously rub the selected
beam's face.

If a beam does not PASS the test, send any character to
the ADCP to automatically select the next beam.

Collecting Statistical Data...
  41  46  45  43  41  46  45  43  41  46  45  42  41  46  44  42

Rub Beam 1 = PASS |   NOTE - Possible cause of failure
Rub Beam 2 = PASS |          DSP Board
Rub Beam 3 = PASS |          Receiver Board
Rub Beam 4 = PASS |          PIO Board
>                 |          Beam
```

5.6 Troubleshooting a Sensor Failure

If the PA test fails the sensor test, run PC2 to isolate the problem. The ambient temperature sensor is mounted on the receiver board. This sensor is imbedded in the transducer head, and is used for water temperature reading. The attitude temperature sensor is located on the PIO board under the compass. The H-ADCP will use the attitude temperature if the ambient temperature sensor fails.

If one of the temperature sensors fails, the PC2 test will show both sensors at the same value.

```
>PC2
Press any key to quit sensor display ...

Heading   Pitch    Roll   Up/Down    Attitude Temp   Ambient Temp   Pressure
301.01°  -7.42°  -0.73°     Up          24.35°C         22.97°C        0.0 kPa
300.87°  -7.60°  -0.95°     Up          24.36°C         22.97°C        0.0 kPa
300.95°  -7.60°  -0.99°     Up          24.37°C         22.97°C        0.0 kPa
300.71°  -7.61°  -0.96°     Up          24.37°C         22.98°C        0.0 kPa
300.69°  -7.61°  -0.96°     Up          24.35°C         22.98°C        0.0 kPa
300.76°  -7.60°  -0.98°     Up          24.38°C         22.97°C        0.0 kPa
>
```

NOTE. If the temperature sensor is bad, the data can still be collected with no effects to accuracy or quality. Contact RDI about scheduling a repair of the temperature sensor at your convenience.

5.6.1 Fault Log

To determine why a sensor failed, view the fault log. To view the fault log, start *BBTalk*. Press the **End** key to wakeup the H-ADCP. Type the following commands: **CR1**, **FC**, **PA**, **FD**. The fault log will be displayed by the FD-command.

```
[BREAK Wakeup A]

H-ADCP Broadband ADCP Version x.xx
RD Instruments (c) 1996-1997
All rights reserved.
>CR1
>FC
>PA
|          (PA test results (not shown))
|
>FD
Total Unique Faults   =     2
Overflow Count        =     0
Time of first fault:   97/11/05,11:01:57.70
Time of last fault:    97/11/05,11:01:57.70

Fault Log:
Entry #  0 Code=0a08h  Count=    1  Delta=    0 Time=97/11/05,11:01:57.70
 Parameter = 00000000h
  Tilt axis X over range.
Entry #  1 Code=0a16h  Count=    1  Delta=    0 Time=97/11/05,11:01:57.70
 Parameter = 00000000h
  Tilt Y axis ADC under range.
End of fault log.
```

5.7 Technical Support

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

RD Instruments	**RD Instruments Europe**
9855 Businesspark Ave.	5 Avenue Hector Pintus
San Diego, California 92131	06610 La Gaude, France
(858) 693-1178	+33(0) 492-110-930
FAX (858) 695-1459	+33(0) 492-110-931
rdifs@rdinstruments.com	rdifs@rdieurope.com

Web: http://www.rdinstruments.com

If your instrument works and you have questions involving a specific application, you may call either the field service group (above) or our sales/marketing staff.

NOTE. When the RDI-US and RDI-Europe office are closed, customers may now call +1 858-578-0781 to have their after-hours emergencies resolved.

5.8 H-ADCP Cables

This section has information on H-ADCP cabling. Special user-requests may cause changes to the basic wiring system and may not be shown here. We provide these drawings only as a guide in troubleshooting the H-ADCP. If you feel there is a conflict, contact RDI for specific information about your system. The following figures show various H-ADCP cable locations, connectors, and pin-outs.

> **NOTE.** Where shown, the color code is for reference only; your cable may be different.

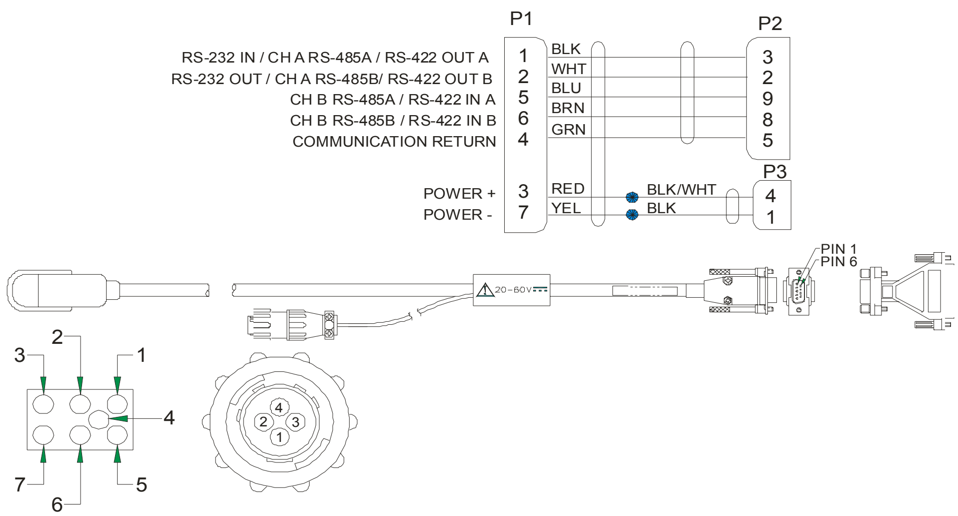


Figure 22. I/O Cable Wiring

> **NOTE.** Where shown, IN refers to signals going into the H-ADCP and OUT refers to signals coming out of the H-ADCP.

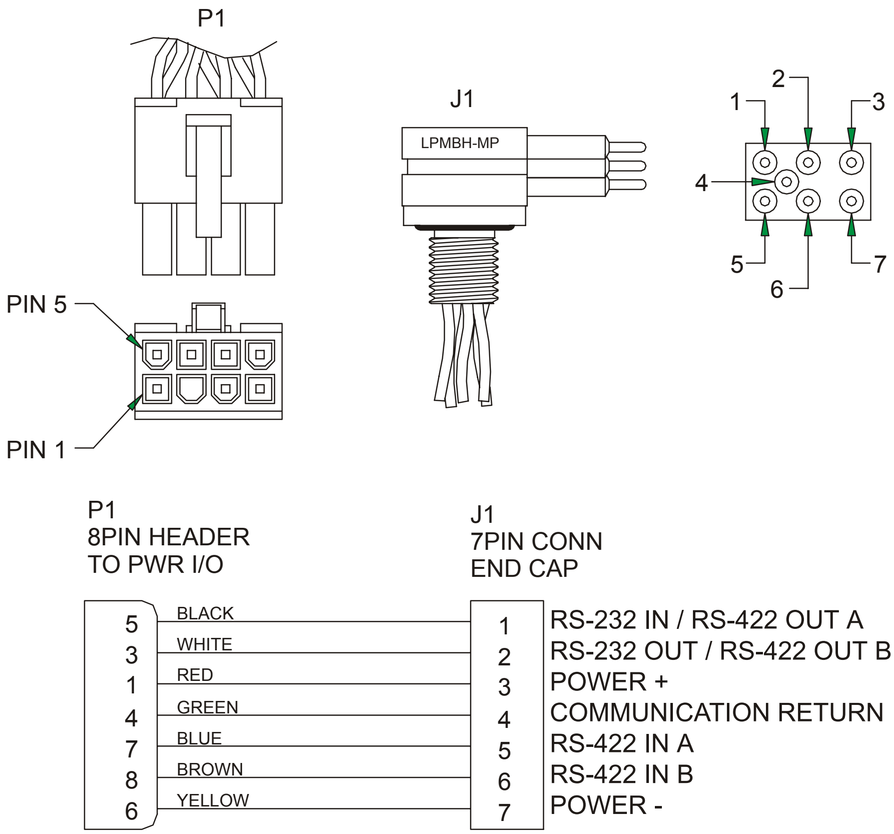


Figure 23. Internal I/O Cable (Housing to PIO Board) Wiring

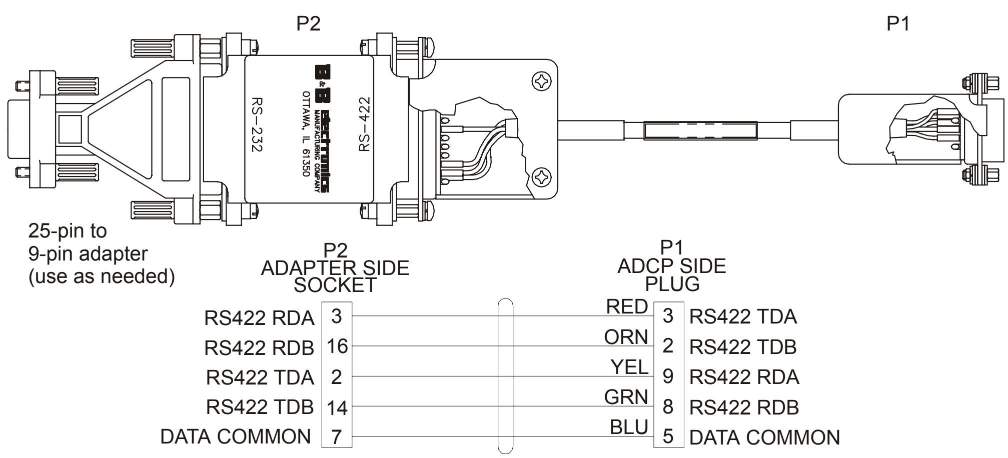


Figure 24. RS232-to-RS422 Converter Wiring (25-Pin to 9-Pin)

> **NOTE.** The converter supplied with the H-ADCP is powered by the computer's COM port. It may be necessary to use a different converter when very long communication lines are used (maximum 1300 meters).

5.9 Functional Description of H-ADCP Operation

This section presents a functional description of H-ADCP operation using block diagrams.

5.9.1 Operating Modes

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

Command Mode

Whenever you wake up your H-ADCP, power dissipation increases from less than 1 mW to around 2.2 W. If you leave the H-ADCP in command mode without sending a command for more than 5 minutes, the H-ADCP automatically goes to sleep. This protects you from inadvertently depleting batteries.

- If the H-ADCP receives a BREAK, it will go to the command prompt and wait for a command. The H-ADCP will wait at the command prompt for five minutes. If no commands have been sent, it will go to sleep (also called "Battery Saver" mode).
- If you press the reset switch (located on the CPU board), the H-ADCP will go to sleep.
- If the H-ADCP receives a CS-command, it will go into the ping mode and begin pinging. If a TF-command (Time of First Ping) was sent prior to the CS-command, then the H-ADCP will go to sleep until the TF time occurs.
- If the H-ADCP does a COLD wakeup (i.e. an unknown state), it will go to the command prompt.
- If the H-ADCP is asleep for approximately nine hours, it wakes up to charge the capacitor used to maintain RAM. Once the capacitor is charged (this only takes a few seconds), the H-ADCP goes back to sleep.

Ping Mode

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

- If the H-ADCP receives a BREAK, it will go to the command prompt, but stays in the ping mode. If a valid command is received, the H-ADCP will switch to the command mode. If no valid command is received, a warning will be displayed after four minutes, indicating that the system will self-deploy. After a total of five minutes with no input, the H-ADCP will resume pinging.

- If you press the reset switch, and an alarm is currently set for the next ping, the H-ADCP will go to sleep. If no alarm is set, the system will start a new deployment and starts pinging immediately unless a TF-command had been set after the last BREAK. In this case, the H-ADCP will go to sleep until the TF time occurs.
- If the H-ADCP does a COLD wakeup, the system will start a new deployment and starts pinging immediately unless a TF-command had been set after the last BREAK. In this case, the H-ADCP will go to sleep until the TF time occurs if the TF time is valid (i.e., not in the past).
- If the H-ADCP is asleep for approximately nine hours, it wakes up to charge the capacitor used to maintain RAM. Once the capacitor is charged, if a valid alarm is set for the next ping time, the H-ADCP goes back to sleep and waits for the alarm. If no alarm is set, the H-ADCP will resume pinging immediately, or wait for the TF time (if valid), and then start pinging.

5.9.2 Overview of Normal H-ADCP Operation

Refer to Figure 25, page 67 through Figure 28, page 70. The following events occur during a typical data collection cycle.

a. The user or a controlling software program sends data collection parameters to the H-ADCP. The user/program then sends a CS-command to start the data collection cycle. The firmware program stored in the CPU microprocessor takes control of H-ADCP operation based on the commands received through the serial I/O cable.

   Figure 25, page 67 shows a flow chart of the wake-up logic used by the H-ADCP. The H-ADCP determines what to do based on where the wake-up came from (a Break, CS-command, battery saver timer, or watchdog timer was detected).

b. On the PIO Board, the POWER REGULATOR circuit sends a transmit command to the POWER AMPLIFIER circuit. This tells the H-ADCP to start acoustic transmissions (pinging) on all TRANSDUCERS.

c. The TRANSDUCERS receive echoes from the backscatter. The RECEIVER board amplifies and translates the echoes into a base-band frequency.

d. The CPU board processes the received echoes.

e. After echo reception, the H-ADCP injects a self-test signal into the RECEIVER board and processes the signal as normal data for test purposes.

f. The THERMISTOR measures water temperature at the transducer head and sends it to the CPU via the DSP Board.

g. The PIO Board sends pitch and roll from the TILT SENSOR and H-ADCP heading from the COMPASS to the DSP Board. The DSP Board digitizes this information and sends it to the CPU for processing.

h. The CPU repeats steps "b" through "g" for a user-defined number of pings. The CPU averages the data from each ping to produce an ensemble data set.

i. At the end of the ensemble (sampling) interval, the CPU sends the collected data to the serial I/O connector or PCMCIA recorder.

5.9.3 Functional Description of Operation

The following paragraphs describe how the H-ADCP operates and interacts with its modules. Refer to Figure 25, page 67 through Figure 28, page 70 throughout this description.

Input Power

The H-ADCP requires a DC supply between 20 volts and 60 volts. Figure 26, page 68 shows the DC voltage power distribution path.

External DC Power Supply – With an external supply, power is applied to pins 3 (positive) and 7 (negative) on the external connector (see Figure 26, page 68). The power then goes through an electromagnetic interference (EMI) filter on the PIO Board. This filter reduces the chance that external noise sources associated with the external power source can disrupt H-ADCP operation.

Board Descriptions

PIO Board.

- Receives the filtered/internal power.
- Uses a diode "OR" gate to determine which power source to use (external or internal). With both sources connected, the OR gate selects the "higher" voltage for H-ADCP use.

- Limits the in-rush of current to the H-ADCP and provides over- and negative-voltage protection. Either condition will blow a protective fuse. However, damage could occur to other circuits before the fuse blows. Please ensure you apply only voltages within the specified range (+20 to +60 VDC.
- Converts the operating power supply (filtered/isolated 20 to 60 VDC or 5 to 18 VDC) in a DC-to-DC converter to the +5 VDC (Vcc) used to power all other H-ADCP circuits.
- Uses the Power Amplifier circuit on the PIO board to generate the high-amplitude pulse AC signal that drives the sonar transducers. The Power Amplifier sends the drive signal to the Receiver Board.
- RS-232/RS-422 switch.

CPU Board.

- Real time clock.
- Generates most of the timing and logic signals used by the H-ADCP.

DSP Board.

- Contains the PCMCIA recorder slots.
- Analog to Digital converter.
- Digitizes information from sensors and sends sensor information to the CPU.

Receiver Board.

- Tuning functions
- Receiver functions
- Temperature sensor
- Interface for pressure sensor

Sensors

This section describes the standard H-ADCP sensors. The PIO and DSP boards control the environmental sensors and contain unit-specific data. Sensors include:

Temperature Sensor (Thermistor) - Used to measure the water temperature. The system uses this data to calculate the speed of sound. This sensor is embedded in the transducer head and is not field replaceable.

Up/Down Sensor - Determines whether the transducer head is facing up or down. This sensor is located on the PIO board.

Compass - Determines the Beam 3 heading angle of the H-ADCP using a flux-gate compass. This sensor is located on the PIO board. The flux-gate measured earth magnetic field vector together with the tilt sensor pitch and roll information is used to determine the heading. Since the tilt sensor data is only valid when the H-ADCP is ±20° from vertical, the heading information is also limited to this range.

Attitude Sensor - Determines the tilt angles of the H-ADCP. This sensor is located on the PIO board. The attitude sensor uses a pitch and roll liquid-filled sensor. This sensor is functional to an angle of ±20° from vertical.

Pressure Sensor (optional) - Measures pressure at the H-ADCP transducer. This sensor is embedded in the transducer head and is not field replaceable.

The CPU microprocessor controls a multiplexed analog-to-digital converter to accept analog data from the sensors. Digital data are taken in directly. The pressure sensor incorporates a Wheatstone Bridge strain gage to measure the water pressure at the transducer faces. Depth is calculated from pressure, with water density adjusted by the salinity (ES) setting.

Calibration data for the sensors, a beam-angle correction matrix, and unit identification parameters (frequency, serial number, firmware version, etc.) are stored in ROM.

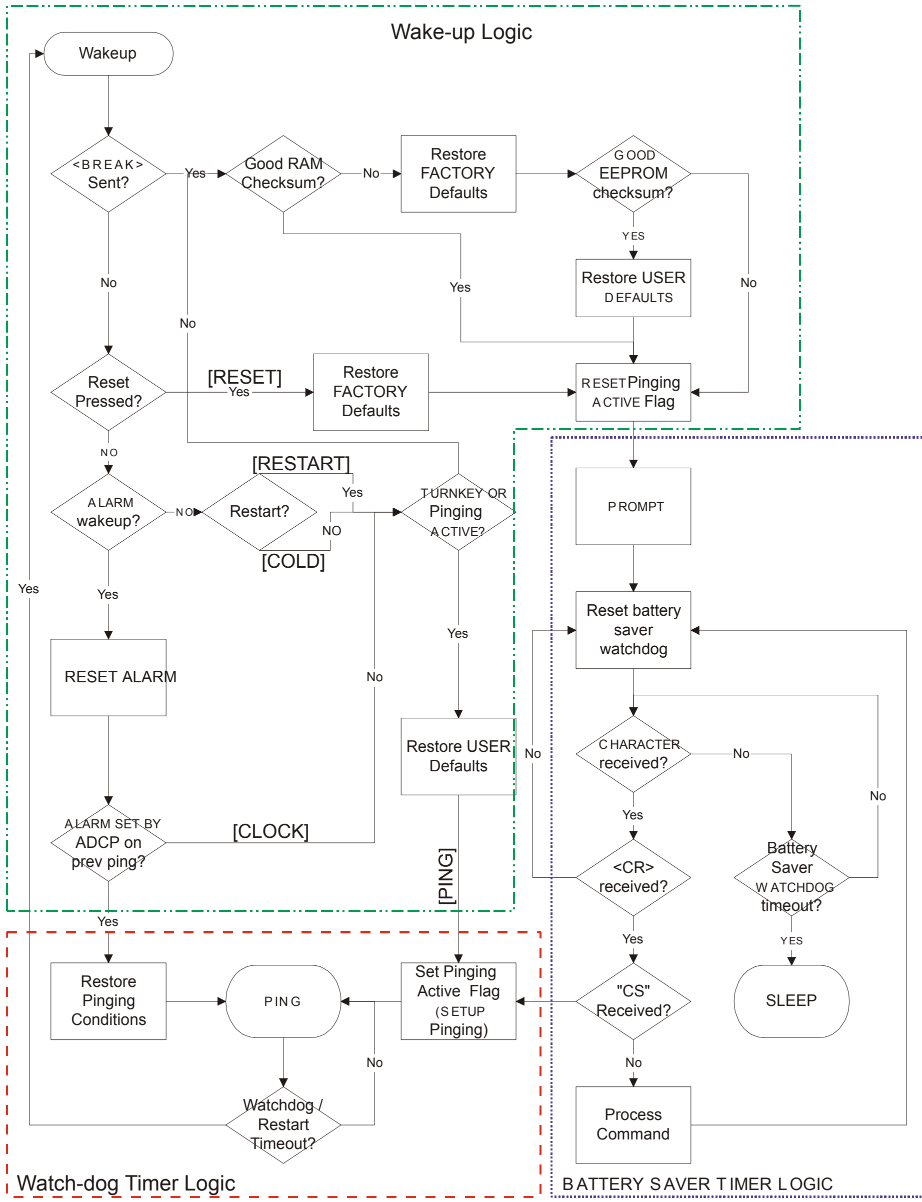


Figure 25. H-ADCP Wake-up and Timer Logic

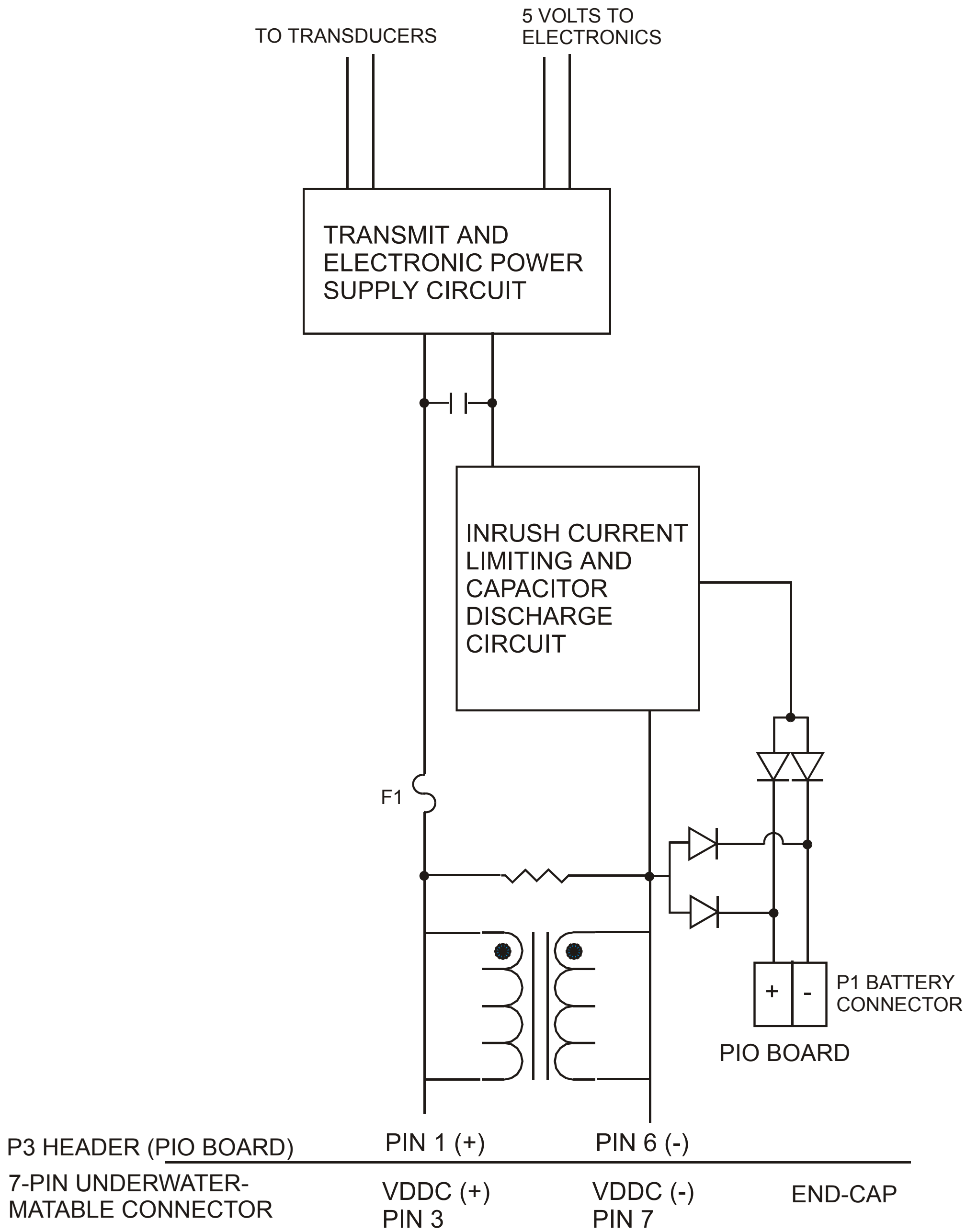


Figure 26. DC Power Path

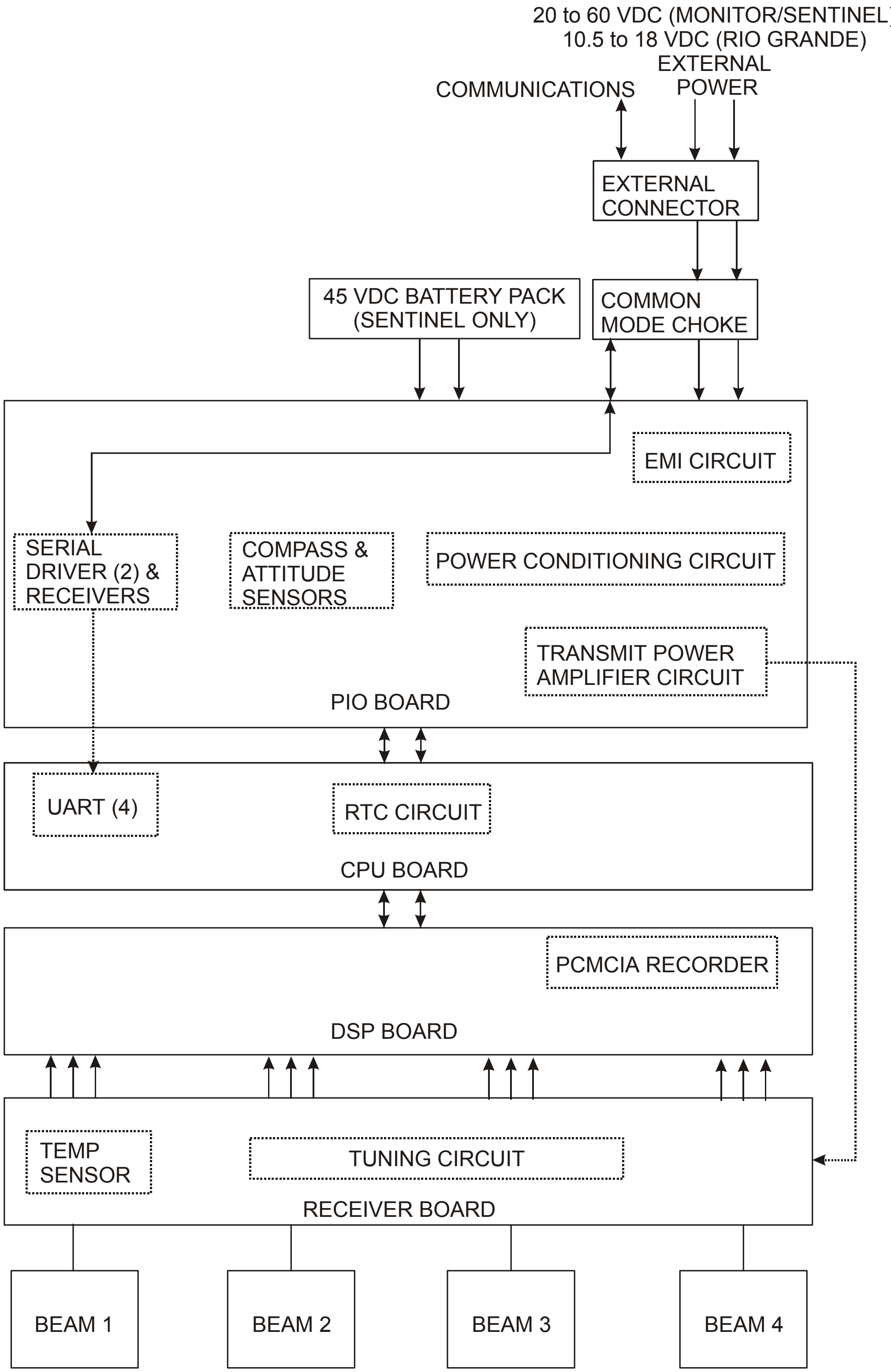


Figure 27. H-ADCP Block Diagram

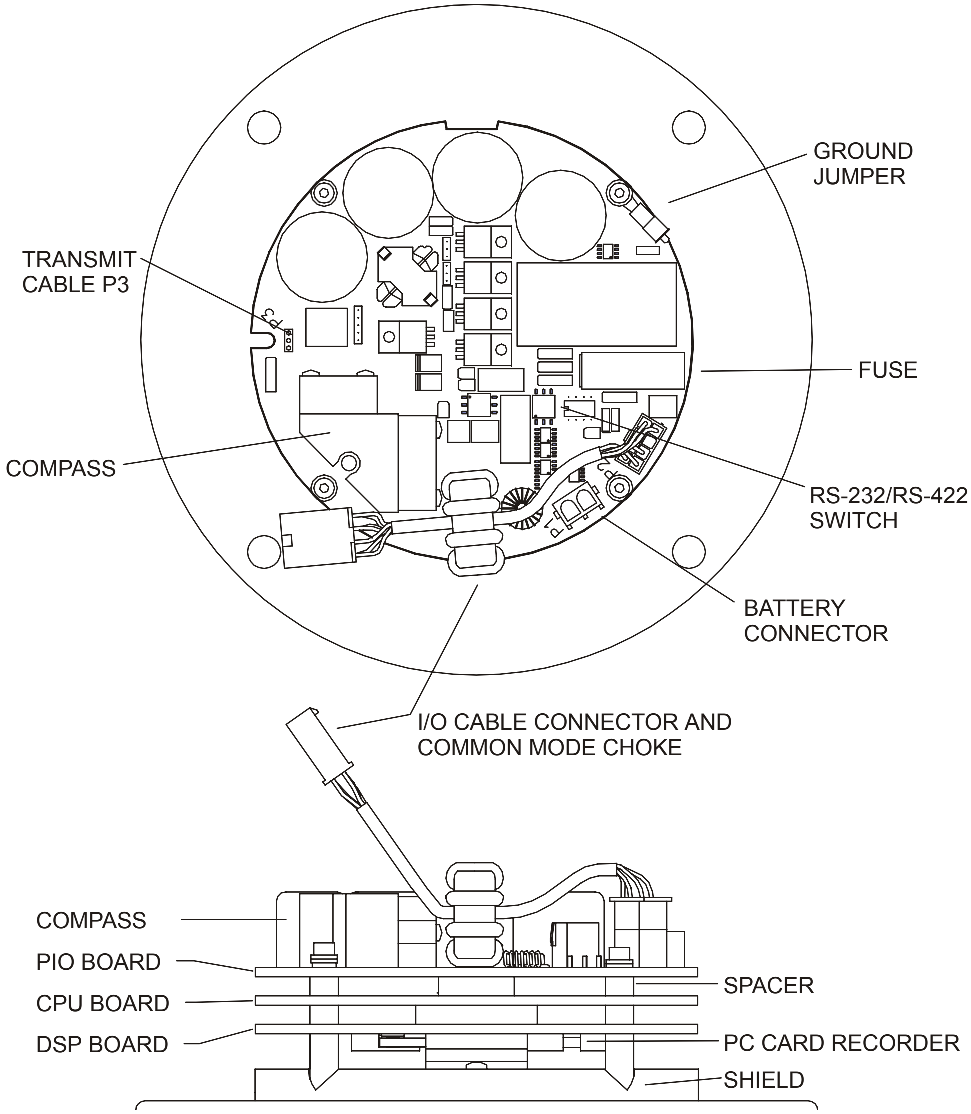


Figure 28. PC Board Locations

6 Specifications

A brief review of ADCP operation may help you understand the specifications listed in this section.

NOTE. The specifications and dimensions listed in this section are subject to change without notice.

The ADCP emits an acoustic pulse called a PING. Scatterers that float ambiently with the water currents reflect some of the energy from the ping back to the ADCP. The ADCP uses the return signal to calculate a velocity. The energy in this signal is the *echo intensity*. Echo intensity is sometimes used to determine information about the scatterers.

The velocity calculated from each ping has a *statistical uncertainty*; however, each ping is an independent sample. The ADCP reduces this statistical uncertainty by averaging a collection of pings. A collection of pings averaged together is an *ensemble*. The ADCP's maximum *ping rate* limits the time required to reduce the statistical uncertainty to acceptable levels.

The ADCP does not measure velocity at a single point; it measures velocities throughout the water column. The ADCP measures velocities from its transducer head to a specified range and divides this range into uniform segments called *cells* (or *bins*). The collection of cells yields a *profile*. The ADCP produces two profiles, one for velocity, and one for echo intensity.

The following tables list the specifications for the H-ADCP. About the specifications:

a. All these specifications assume minimal ADCP motion - pitch, roll, heave, rotation, and translation.

b. Except where noted, this specification table applies to typical setups and conditions. Typical setups use the default input values for each parameter (exceptions include Pings Per Ensemble and Number of Cells). Typical conditions assume uniform seawater velocities at a given depth, moderate shear, moderate ADCP motion, and typical echo intensity levels.

c. The total measurement error of the ADCP is the sum of:

- Long-term instrument error (as limited by instrument accuracy).
- The remaining statistical uncertainty after averaging.
- Errors introduced by measurement of ADCP heading and motion.

d. Because individual pings are independent, the statistical uncertainty of the measurement can be reduced according to the equation:

$$\frac{\text{Statistical Uncertainty for One Ping}}{\sqrt{\text{Number of Pings}}}$$

Table 6: Water Profiling

Cell Size[1]	Nominal range 15m[2] 1200kHz		Nominal range 55m[2] 600kHz		Nominal range 135m[2] 300kHz	
Vertical Resolution	Range[3] (m)	Std. dev.[4] (mm/s)	Range[3] (m)	Std. dev.[4] (mm/s)	Range[3] (m)	Std. dev.[4] (mm/s)
0.25m	12	182				
0.50m	13	66	40	182		
1.0m	15	30	45	66	97	182
2.0m	16	18	50	30	110	66
4.0m			56	18	123	30
8.0m					138	18

NOTES

1. User's choice of cell size is not limited to the typical values specified.
2. Longer ranges are available.
3. Range, which depends on cell size, is specified here for BroadBand mode at 5° C, typical ocean backscatter, and nominal 48 VDC power.
4. Broad bandwidth mode single-ping standard deviation

Table 7: Long Range Mode

	Range (m) @ 33VDC	Range (m) @ 48VDC	Depth Cell Size (m)	Std. dev. (mm/s)
1200kHz	19	20	2	35
600kHz	67	70	4	38
300kHz	165	175	8	38

Range, which depends on cell size, is specified here for narrow bandwidth mode at 5° C, typical ocean backscatter, and nominal 48VDC input power.

Table 8: Profile Parameters

Velocity accuracy	
1200 and 600kHz	± 0.25% of the water velocity relative to the ADCP ± 2.5mm/s
300kHz	± 0.5% of the water velocity relative to the ADCP ± 5 mm/s
Velocity resolution	l mm/s
Velocity range	± 5m/s (default), ± 20m/s (maximum)
Number of cells	1 to 128
Ping rate	2 Hz (typical)

Table 9: Echo Intensity Profile

Vertical resolution	Depth cell size
Dynamic range	80 dB
Precision	± 1.5dB (relative measure)

Table 10: Standard Sensors

Temperature (mounted on transducer)

Range: -5° to 45° C

Precision: ± 0.4° C

Resolution: 0.01°

Tilt

Range: ± 15°

Accuracy: ± 0.5°

Precision: ± 0.5°

Resolution: 0.01°

Compass (fluxgate type, includes built-in field calibration feature)

Accuracy: ± 2°[1]

Precision: ± 0.50[1]

Resolution: 0.01°

Maximum tilt: ± 15°

Note: 1) @ 60° magnetic dip angle, 0.5G total field

Table 11: Transducer and Hardware

Beam angle	25° or 30°
Configuration	3 beam, convex
Internal memory	Memory card not included with H-ADCP models. Two PCMCIA memory cards slots are available, with the total memory capacity not to exceed 2GB.
Communications	Serial port selectable by switch for RS-232 or RS-422. ASCII or binary output at 1200 to 115,200 baud.

Table 12: Environmental

Standard depth rating	200m.
Operating temperature	-5° to 45°C
Storage temperature	-30° to 60°C
Weight	See outline Installation Drawings

Table 13: Power

	DC input	20 to 60 VDC external power supply
	Transmit	22W @ 48V (1200kHz), 60W @ 48V (600kHz), 190W @ 48V (300kHz)
Special Order		
	DC Input	10.5 to 18 VDC
	Transmit	35W @ 13V (600kHz), 25W @ 13V (1200kHz)

6.1 Outline Installation Drawings

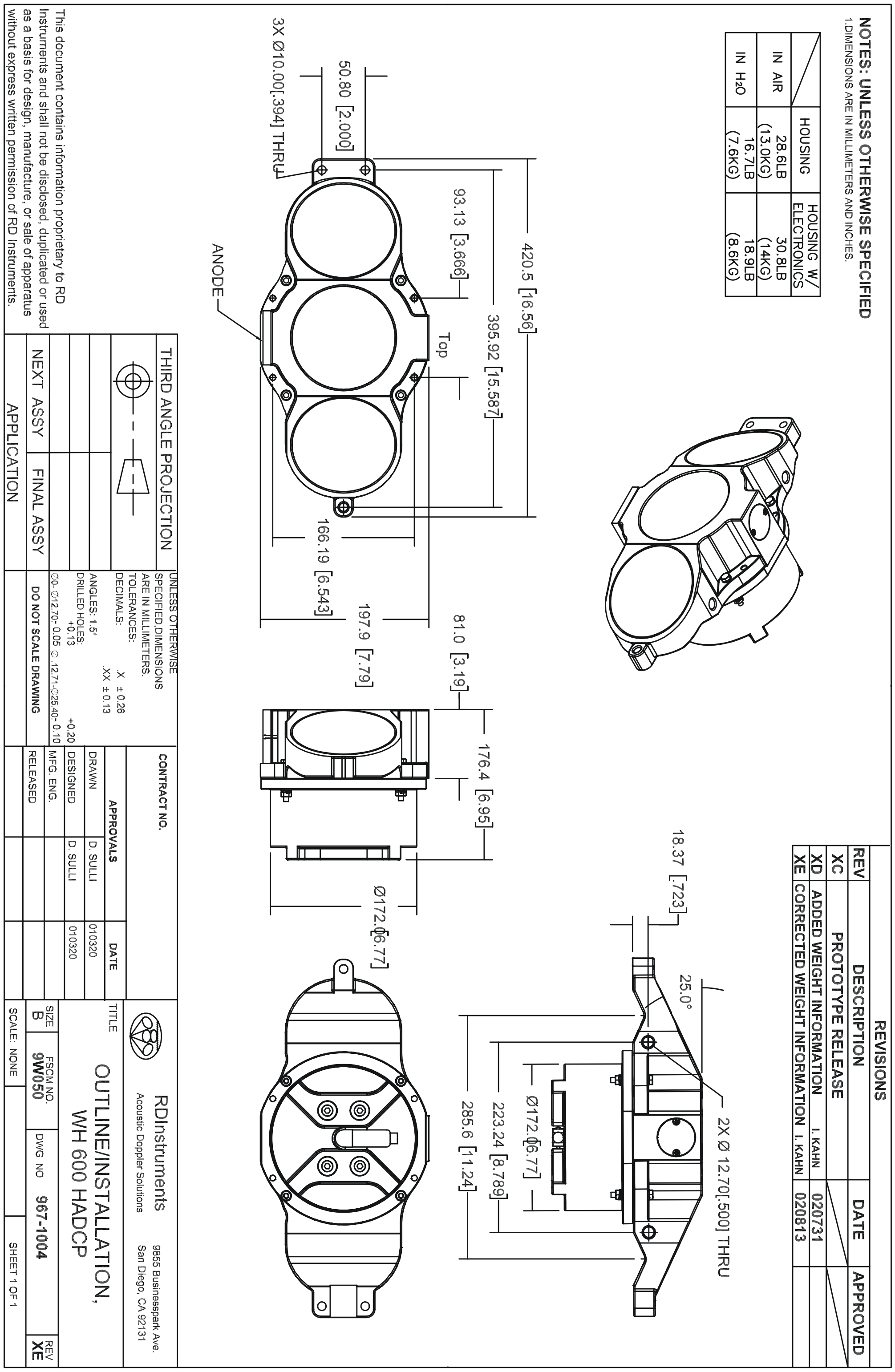
The following drawings show the standard H-ADCP dimensions and weights.

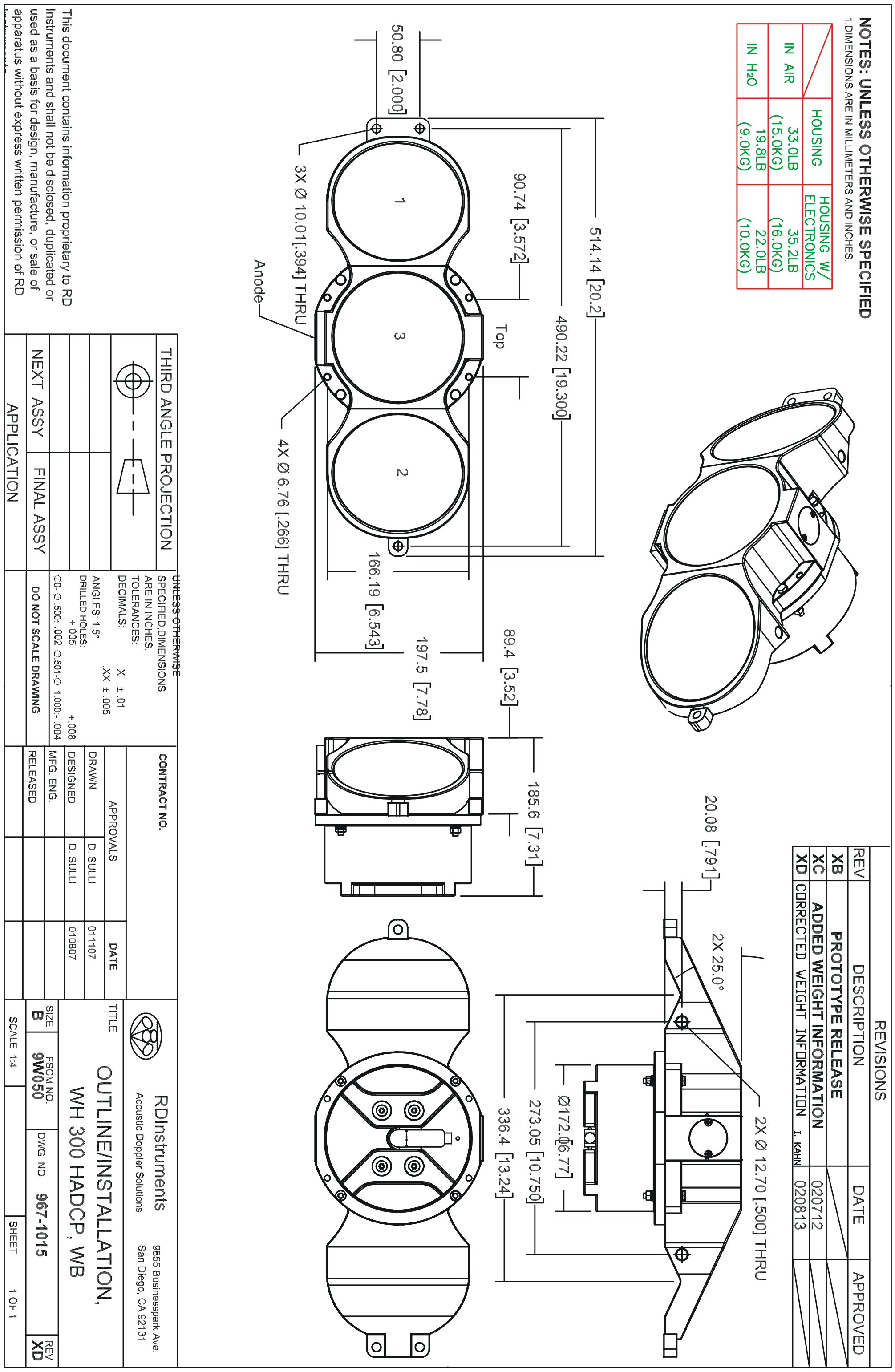
Table 14: Outline Installation Drawings

Description	Drawing #
600kHz H-ADCP	967-1004
300kHz WB H-ADCP	967-1015
300kHz 20 Degree H-ADCP	967-6043

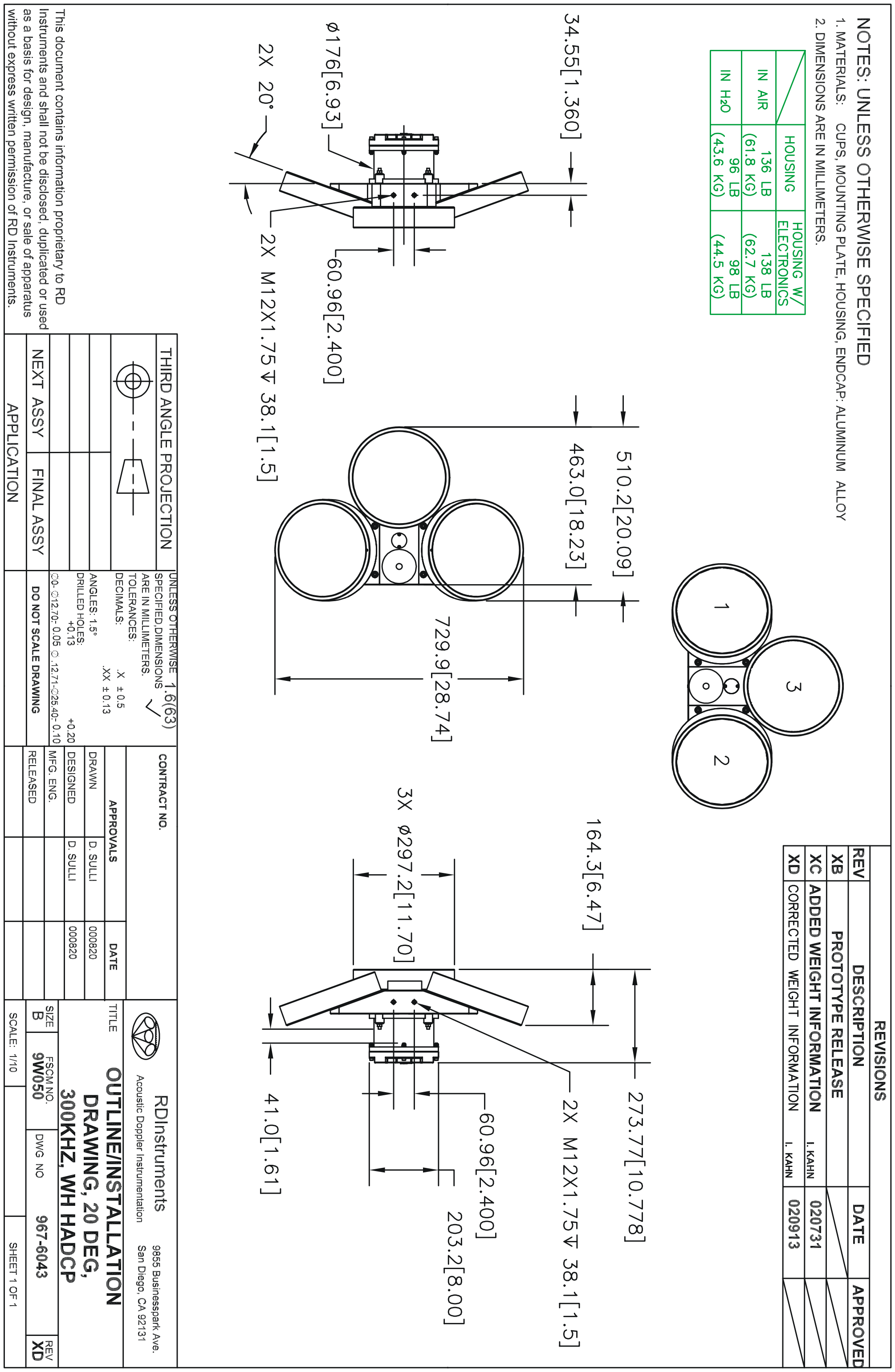
NOTE. If you are having difficulty reading the text on the Outline Installation drawings, the Acrobat Reader allows you to zoom in and rotate the graphics.

CAUTION. Outline Installation Drawings are subject to change without notice. Verify you have the latest version of the drawing by contacting RDI before building mounts or other hardware.


NOTES: UNLESS OTHERWISE SPECIFIED
1.DIMENSIONS ARE IN MILLIMETERS AND INCHES.
HOUSING
HOUSING W/ ELECTRONICS
IN AIR
28.6LB (13.0KG)
30.8LB (14KG)
IN H2O
16.7LB (7.6KG)
18.9LB (8.6KG)
REVISIONS
REV DESCRIPTION DATE APPROVED
XC PROTOTYPE RELEASE
XD ADDED WEIGHT INFORMATION I. KAHN 020731
XE CORRECTED WEIGHT INFORMATION I. KAHN 020813
420.5 [16.56]
395.92 [15.587]
93.13 [3.666]
50.80 [2.000]
3X Ø10.00[.394] THRU
ANODE
Top
166.19 [6.543]
197.9 [7.79]
81.0 [3.19]
176.4 [6.95]
Ø172.0[6.77]
18.37 [.723]
25.0°
2X Ø 12.70[.500] THRU
Ø172.0[6.77]
223.24 [8.789]
285.6 [11.24]
This document contains information proprietary to RD Instruments and shall not be disclosed, duplicated or used as a basis for design, manufacture, or sale of apparatus without express written permission of RD Instruments.
THIRD ANGLE PROJECTION
NEXT ASSY
FINAL ASSY
APPLICATION
UNLESS OTHERWISE SPECIFIED, DIMENSIONS ARE IN MILLIMETERS.
TOLERANCES:
DECIMALS: .X ± 0.26 .XX ± 0.13
ANGLES: ±1.5°
DRILLED HOLES
DO NOT SCALE DRAWING
CONTRACT NO.
APPROVALS
DATE
DRAWN D. SULLI 010320
DESIGNED D. SULLI 010320
MFG. ENG.
RELEASED
RDInstruments
Acoustic Doppler Solutions
9855 Businesspark Ave.
San Diego, CA 92131
TITLE
OUTLINE/INSTALLATION,
WH 600 HADCP
SIZE B
FSCM NO. 9W050
DWG NO 967-1004
REV XE
SCALE: NONE
SHEET 1 OF 1



NOTES: UNLESS OTHERWISE SPECIFIED
1.DIMENSIONS ARE IN MILLIMETERS AND INCHES.
HOUSING
HOUSING W/ ELECTRONICS
IN AIR
33.0LB (15.0KG)
35.2LB (16.0KG)
IN H2O
19.8LB (9.0KG)
22.0LB (10.0KG)
REVISIONS
REV
DESCRIPTION
DATE
APPROVED
XB
PROTOTYPE RELEASE
XC
ADDED WEIGHT INFORMATION
020712
XD
CORRECTED WEIGHT INFORMATION
020813
514.14 [20.2]
490.22 [19.300]
90.74 [3.572]
50.80 [2.000]
3X Ø 10.01[.394] THRU
Anode
Top
4X Ø 6.76 [.266] THRU
166.19 [6.543]
197.5 [7.78]
89.4 [3.52]
185.6 [7.31]
20.08 [.791]
2X 25.0°
2X Ø 12.70 [.500] THRU
Ø172.0[6.77]
273.05 [10.750]
336.4 [13.24]
1
2
3
This document contains information proprietary to RD Instruments and shall not be disclosed, duplicated or used as a basis for design, manufacture, or sale of apparatus without express written permission of RD
THIRD ANGLE PROJECTION
NEXT ASSY
FINAL ASSY
APPLICATION
UNLESS OTHERWISE SPECIFIED,DIMENSIONS ARE IN INCHES.
TOLERANCES:
DECIMALS:
X ±.01
.XX ±.005
ANGLES: 1.5°
DRILLED HOLES:
DO NOT SCALE DRAWING
CONTRACT NO.
APPROVALS
DATE
DRAWN
D. SULLI
011107
DESIGNED
D. SULLI
010807
MFG. ENG.
RELEASED
RDInstruments
Acoustic Doppler Solutions
9855 Businesspark Ave.
San Diego, CA 92131
TITLE
OUTLINE/INSTALLATION,
WH 300 HADCP, WB
SIZE
B
FSCM NO.
9W050
DWG NO
967-1015
REV
XD
SCALE 1:4
SHEET
1 OF 1


NOTES: UNLESS OTHERWISE SPECIFIED
1. MATERIALS: CUPS, MOUNTING PLATE, HOUSING, ENDCAP: ALUMINUM ALLOY
2. DIMENSIONS ARE IN MILLIMETERS.
HOUSING
HOUSING W/ ELECTRONICS
IN AIR 136 LB (61.8 KG) 138 LB (62.7 KG)
IN H2O 96 LB (43.6 KG) 98 LB (44.5 KG)
34.55[1.360]
ø176[6.93]
2X 20°
2X M12X1.75 ▽ 38.1[1.5]
60.96[2.400]
510.2[20.09]
463.0[18.23]
729.9[28.74]
1
2
3
3X ø297.2[11.70]
164.3[6.47]
273.77[10.778]
2X M12X1.75 ▽ 38.1[1.5]
60.96[2.400]
203.2[8.00]
41.0[1.61]
REVISIONS
REV DESCRIPTION DATE APPROVED
XB PROTOTYPE RELEASE
XC ADDED WEIGHT INFORMATION I. KAHN 020731
XD CORRECTED WEIGHT INFORMATION I. KAHN 020913
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THIRD ANGLE PROJECTION
NEXT ASSY FINAL ASSY
APPLICATION
UNLESS OTHERWISE SPECIFIED,DIMENSIONS ARE IN MILLIMETERS.
TOLERANCES:
DECIMALS: .X ± 0.5 .XX ± 0.13
ANGLES: 1.5°
DRILLED HOLES:
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CONTRACT NO.
APPROVALS DATE
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DESIGNED D. SULLI 000820
MFG. ENG.
RELEASED
RDInstruments
Acoustic Doppler Instrumentation
9855 Businesspark Ave. San Diego, CA 92131
TITLE
OUTLINE/INSTALLATION DRAWING, 20 DEG, 300KHZ, WH HADCP
SIZE B
FSCM NO 9W050
DWG NO 967-6043
REV XD
SCALE: 1/10
SHEET 1 OF 1

7 Glossary

If, after reviewing this section, you are unable to find the word/jargon in question, please **send us an e-mail** containing that word. Your questions will ensure that our glossary remains an effective reference tool for our customers.

------ A ------

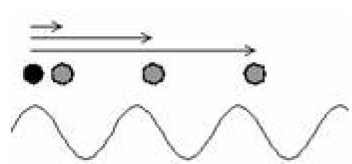
Acoustic Doppler Current Profiler (ADCP): An instrument that obtains profiles of water velocity by transmitting sound of known frequency into the water and measuring the Doppler shift of reflections from scatterers, which are assumed to be passively moving with the water.

Acoustic Window: A covering for the hull-side opening of a sea chest that is transparent to sound. A vessel mounted ADCP is typically mounted in a sea chest and the acoustic window helps to isolate it from biofouling organisms and also the flow noise generated by the vessel.

ADCP: Acoustic Doppler Current Profiler

ADCP Coordinates: Profile data is reported in an orthogonal coordinate system as referenced to the instrument. Beam 3 is forward. Sideways is to the right of forward (beam 2 for a down-looking ADCP, beam 1 for an up-looking ADCP).

Ambiguity: ADCPs determine the radial motion between a source and scatterer by measuring the phase change of the reflected signal. Because phase is periodic, this solution is multi-valued. For example, all three of the displacements shown below will return the same phase measurement, which results in ambiguity:



Ambiguity Resolution: A method to count the number of wavelengths included between two points where phase is measured, thereby removing the ambiguity associated with measuring only phase.

Ambiguity Velocity: The maximum allowable radial motion for phase measurements to be unambiguous, corresponding to a maximum observable velocity, beyond which ambiguity resolution is required.

Autonomous Underwater Vehicle (AUV): An unmanned submersible with propulsion, generally capable of navigation and accomplishing specific tasks (such as data gathering).

AUV: Autonomous Underwater Vehicle

------ B ------

Backscatter: 1) The portion of a sound wave that is reflected by scatterers directly back toward the source. 2) A qualitative measurement (in decibels) of scatterer concentration which is calculated in the WinRiver software. This calculation corrects the echo intensity data for sound absorption, beam spreading, transducer temperature, etc. and provides an excellent means of tracking relative concentration (e.g. "Is most of the sediment in the water here or is it there?"). Obtaining a quantitative measurement (e.g. "How many mg/L of bottom sediment are in this parcel of water?") requires a field calibration at the measurement site. There is a third-party software package, *Sediview*, designed for this task.

BBBatch: Utility program to allow automated conversion of a series of raw binary ADCP files to ASCII files.

BBCheck: Utility program that checks the integrity and quality of raw binary ADCP files.

BBConv: Utility program to convert some portion of a raw binary ADCP file into an ASCII file using a decoder file. Several decoder files are included on the RDI Tools CD, for example: extract only distance to first bin, extract only navigation data, etc. Complete documentation on these decoder files as well as information on how to write your own is available.

BBList: Utility program for viewing and converting raw binary ADCP data files. It is a menu-driven program offering a step-by-step process to convert raw binary files to ASCII files.

BBMerge: Utility program to convert comma-delimited ASCII files back into raw binary ADCP format.

BBSlice: A raw data sub-sectioning utility program. BBSlice converts a raw data file into a series of ASCII files, opening a new ASCII file whenever there is a jump in the sequence of ensemble numbers.

BBss: Utility program to calculate the speed of sound when given temperature, salinity and depth.

BBSub: A raw data sub-sectioning utility program. BBSub allows you to extract subsets of raw data from a large raw data file by choosing the starting and ending ensemble number.

BBTalk: Terminal emulator program for direct communication with the CPU of an ADCP or DVL.

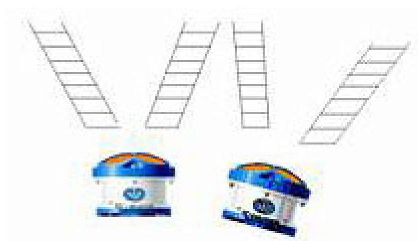
Beam Angle: The angle between a transducer beam's main axis and the vertical axis of the ADCP or DVL (typically 20 or 30º).

Beam Coordinates: Profile data is reported as referenced along each beam (i.e. no coordinate transformation is performed upon the raw data).

Beam Spreading: The extent to which the main lobe of energy generated by a transducer fans out, or spreads as an acoustic wave front, with distance from the transducer. This is proportional to λ/d where λ is the wavelength of sound generated and d is the diameter of the transducer. Note: this is why ADCP transducer diameter increases with decreasing operating frequency (and increasing wavelength).

Bin (Depth Cell): A measurement within a profile, generally equivalent to a single-point current meter on a mooring.

Bin Mapping (Depth Cell Mapping): When the ADCP is tilted; the measurements taken at equal distances along each beam are no longer in the same horizontal layer of water. For example, in the image below the tilted ADCP bins do not line up horizontally, they are offset by one bin. In this case the tilted ADCP will offset the bins on the “right” beam by one bin in order to line them up horizontally with the bins on the “left” beam before combining the measurements to compute the velocity.



Blank Zone: The area near the head of an ADCP in which no measurements are taken. This is usually the minimum distance required to avoid collecting data that is potentially contaminated by ringing, but is sometimes extended for other reasons (e.g. to begin measurement well beyond the flow influence of a mounting structure).

Bottom Discharge: When using an ADCP to measure river discharge, it is not possible to measure all the way to the bottom (due to sidelobe contamination and the finite resolution of the depth cells). In order to get an accurate approximation of the total discharge, the flow in this area must be estimated and included, usually by extrapolating the measured velocities to the bottom using a power curve fit.

Bottom Track: In moving platform applications where the bottom is within range of the ADCP or DVL, a special ping can be transmitted to measure the Doppler shift of the signal return from the bottom. If the bottom is not moving, this measurement is a very accurate measurement of the platform velocity. For ADCPs this velocity is typically used to extract the true water velocity profile from the measured velocity profile (by removing the vehicle motion from the measurements). For DVLs, this IS the desired velocity.

Bottom Track Modes: There are currently four bottom tracking modes of operation available from RDI:

> **Bottom Mode 4:** Uses ambiguity resolution, and adjusts lags for reduced variance at higher elevations (or deeper depths).
>
> **Bottom Mode 5:** Specifically designed for reduced variance in shallow water/low elevations. It transmits several pings with computations to best determine depth and speed. This mode is the default mode, but it will automatically switch to Bottom Mode 4 if conditions warrant.
>
> **Bottom Mode 6:** Offers special narrow bandwidth operation to reduce the potential for interference or for stealth. No ambiguity resolution, instead bottom mode 6 requires user input of an approximate operating elevation (or depth).
>
> **Bottom Mode 7:** Similar to bottom mode 5, except that it is optimized for slow-moving platforms in very shallow, high backscatter environments.

Break: A wake up command to an ADCP or DVL that places the instrument in command mode.

Broadband ADCP: An ADCP that uses broadband processing.

Broadband Processing: Use of coded pulses to make multiple measurements of phase with a single ping, and thereby greatly increase the precision of the measurement.

------ C ------

Channel Master: Model name for an ADCP designed to use horizontal profiling for flow monitoring in inland waterways.

Command Mode: The state into which an ADCP or DVL goes upon receiving a break. In this mode the ADCP or DVL is waiting to receive a command. It draws relatively high power, so the ADCP or DVL will go to sleep if no command is received for five minutes.

Correlation: A key quality control parameter, this is essentially a measurement of how much the particle distribution has changed between phase measurements. The less the distribution has changed, the higher the correlation, and the more precise the velocity measurement.

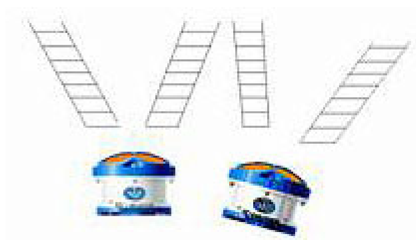
------ D ------

Dead Reckoning: A navigation method where position is estimated by measuring velocity, heading and time from the last known position.

Degaussing: Technique used to remove the magnetic field from RDI battery packs before installation, done to minimize any effects the batteries will have on the magnetic compass.

Depth Cell (Bin): A measurement within a profile, generally equivalent to a single-point current meter on a mooring.

Depth Cell Mapping (Bin Mapping): When the ADCP is tilted; the measurements taken at equal distances along each beam are no longer in the same horizontal layer of water. For example, in the image below the tilted ADCP bins do not line up horizontally, they are offset by one bin. In this case the tilted ADCP will offset the bins on the "right" beam by one bin in order to line them up horizontally with the bins on the "left" beam before combining the measurements to compute the velocity.



DGPS: Differential Global Positioning System

Differential Global Positioning System (DGPS): Satellite-based navigation aid for precise measurement of location. When the bottom is out of range or moving, calculating the distance between DGPS position fixes and dividing by the time between those fixes can be used to measure the platform velocity.

Direct-Reading ADCP: An ADCP intended for real-time operation. Direct-Reading ADCPs do not have internal batteries or an internal recorder.

Discharge: The total flow through a section of a river. Rio Grande ADCPs obtain discharge measurements by transecting the river to measure water velocities, boat velocity, and the cross sectional area of the river and combining these measurements with estimates for the flow in the areas that can not be measured (edge estimates, bottom discharge and top discharge).

Distance Made Good: When measuring transects of data with a moving platform, this is a measure of the actual distance between the platform and the start point (i.e. variations in course track are removed).

Doppler Shift: Named for Johann Doppler (1803-1853), the German physicist who first predicted it: it is the shift in frequency caused by radial motion between a source and an observer. Specifically, $f_D = f_S\,(v/c)$: Where D is the Doppler-shifted frequency, f_S is the source frequency, v is the relative velocity between source and observer, and c is the speed of sound.

Doppler Velocity Log (DVL): An instrument designed to measure the velocity and elevation of a moving platform with bottom tracking. Most DVLs will switch to measuring velocity relative to the water when the bottom is out of range.

DVL: Doppler Velocity Log.

------ E ------

Earth Coordinates: Profile data is reported in an orthogonal coordinate frame as referenced to the Earth (East, North and Up). "North" can mean magnetic or true, depending on the heading input.

Echo Intensity: A key quality control parameter, echo intensity is a measure of the signal strength intensity returned to the transducer. High echo intensity can show solid targets (e.g. a boundary, obstruction or fish), while low echo intensity can show insufficient scatterers or the limits of profiling range for the environment.

Edge Estimate: When measuring river discharge with an ADCP it is not possible to measure to zero depth at the banks of the river. The flow through this unmeasured area must be approximated in order to obtain an accurate estimate of the total discharge.

Ensemble: A group of measurements (pings) considered together. An ensemble is usually the average of the individual measurements, and has a higher precision than any individual measurement.

Error Velocity: A key quality control parameter that derives from the four beam geometry of an ADCP. Each pair of opposing beams provides one measurement of the vertical velocity and one component of the horizontal velocity, so there are actually two independent measurements of vertical velocity that can be compared. If the flow field is homogeneous, the difference between these vertical velocities will average to zero. To put the error velocity on a more intuitive footing, it is scaled to be comparable to the variance in the horizontal velocity. In a nutshell, the error velocity can be treated as an indication of the standard deviation of the horizontal velocity measurements.

------ F ------

Fish Detection Threshold: Used to identify and mark as bad any velocity measurement that was potentially contaminated by a fish (because fish are generally not passively following the flow). It is a flag on the maximum allowable value for the measured echo intensity return.

Frequency: The number of wave crests passing a given point per unit time.

------ G ------

Gimbals: Frame that will support the weight of an object but allow its free rotation. Gimbals can be constructed to allow free rotation in one, two, or three axes.

GO-DVL: DOS batch file used to configure a Navigator and start data collection with *Shiptrack*.

Gyro: A rapidly spinning device mounted on gimbals to maintain a constant orientation. These devices are commonly used to measure heading on ships because, unlike magnetic compasses, they are unaffected by ferrous metals or by varying electromagnetic fields. They can also be used to measure pitch and roll because, unlike liquid level sensors, they are unaffected by accelerations.

------ H ------

Homogeneity: The extent to which the current measured by all four beams is the same. A key assumption of all ADCP processing is that the currents are horizontally homogeneous across the four beams. This assumption is checked for each measurement by using the error velocity measurement.

Horizontal ADCP (H-ADCP): Instrument designed to measure velocity profiles in a horizontal plane.

------ I ------

Inertial Navigation: Method for estimating the attitude and position of a moving platform (of primary interest here are AUVs) by integrating measurements from gyros and accelerometers. This integration is subject to large errors over time, so DVLs and pressure sensors are commonly incorporated as external inputs to measure and correct these errors.

------ J ------

------ K ------

------ L ------

Lag: A time delay between pulses or pings.

Long Ranger: Model name for Workhorse ADCPs of frequency 75 kHz.

Lowered ADCP (L-ADCP): Technique whereby one or two ADCPs are lowered through the water column (typically on a rosette) to obtain velocity profiles over the full ocean depth. Note that a whole body of research exists on how to properly remove the motion of the rosette from the velocity measurements obtained in this manner.

------ M ------

Main Lobe: The main focus of energy emitted from a transducer. If the transducer were a flashlight, the main lobe would be the visible beam of light.

Mariner: Model name for a Workhorse Monitor ADCP configured for underway current measurement in shallow water (as opposed to the deep water Ocean Surveyor systems).

Modes: RDI offers several modes of operation that are optimized for certain conditions. There are currently five modes of operation for water profiling available from RDI:

> **Mode 1:** General purpose water profiling. This is the most robust profiling mode, designed for the widest variety of measurement applications. Mode 1 can resolve high velocities and can measure over long ranges.
>
> **Mode 5:** For high resolution profiling in shallow water with low flows. Mode 5 should be used with bottom tracking. It offers the lowest standard deviation per measurement, but is also the most limited in its allowed performance envelope (e.g. low velocity flow, slow platform movement, no high shears or turbulence).
>
> **Mode 8:** Also for high resolution profiling in shallow water. Mode 8 should also be used with bottom tracking. It has higher standard deviation per measurement than mode 5, but allows a somewhat wider performance envelope.
>
> **Mode 11:** The latest in our high resolution profiling modes. Intended for the shallowest water, it is also well suited for boundary layer studies. Mode 11 should be used with bottom tracking. It allows smaller depth cells (1 cm), more depth cells, and has improved signal processing which allows faster ping rates and a wider performance envelope than modes 5 and 8. Mode 11 is intended to supercede mode 5.
>
> **Mode 12:** Offers increased resolution (1 cm depth cells) and uses multiple sub-pings to improve the standard deviation of each measurement. Mode 12 allows measurement of fast moving, shallow water; and can also be used to improve the standard deviations of any measurement (any range, any velocity) when the ADCP heading is fixed or reasonably steady.

Monitor: Model name for a direct reading Workhorse ADCP.

Moving Bottom: Some rivers carry such a heavy sediment load that they do not have a clearly identifiable bottom. In essence, the mud just keeps getting thicker and slower with depth. In such environments it is not uncommon for bottom tracking measurements to lock onto a sediment layer that is still moving, resulting in a bias to the bottom tracking velocity. This is especially important for river discharge measurements, where the vessel's navigation must be substituted for the bottom track velocity to obtain accurate results.

------ N ------

Navigator: Model name for the RDI Doppler Velocity Log.

Narrowband ADCP: An ADCP that uses narrowband processing.

Narrowband Processing: Uses a single pulse per ping to measure velocity. The lack of coding in the pulse makes a narrowband measurement much less precise, but it allows profiling over a longer range. Narrowband processing generally requires much larger ensembles to get a precise measurement.

------ O ------

Ocean Observer: Low frequency Phased Array ADCP for cabled deployment, usually from an oilrig.

Ocean Surveyor: Low frequency Phased Array ADCP for vessel-mounted operations.

------ P ------

Percent Good: A key quality control parameter, percent good indicates what fraction of the pings passed the various error thresholds. Each depth cell reports four values for percent good, and the meaning depends on the coordinate frame. If data is collected in beam coordinates, then the four percent good values represent the percentage of the pings collected by each beam for that depth cell whose correlation exceeded a low correlation threshold. In the other coordinate frames (ADCP, Ship and Earth Coordinates), the four Percent Good values represent (in order): 1) The percentage of good three beam solutions (one beam rejected); 2) The percentage of good transformations (error velocity threshold not exceeded); 3) The percentage of measurements where more than one beam was bad; and 4) The percentage of measurements with four beam solutions.

Phase: An engineering measure of the propagation delay caused by radial motion between scatterer and source. Phase is ambiguous in that it is cyclical (e.g. 10 º is the same phase as 370 º).

Phased Array Transducer: A single, flat, multi-element transducer that uses an RDI proprietary technique to simultaneously form all four beams. Available phased array transducers are generally low frequency (38 kHz, 75 kHz and 150 kHz) long range devices.

Ping: The entirety of the sound generated by an ADCP transducer for a single measurement cycle. A broadband ping contains a coded series of pulses and lags, while a narrowband ping contains a single pulse.

Ping Mode: Power conserving mode for a deployed ADCP or DVL, where only the power needed for the immediate deployment task is drawn (as opposed to command mode, where the ADCP consumes considerable power while simply waiting for input). This mode saves the deployment configuration so that, in the event of a power interruption, the ADCP or DVL will be able to automatically resume the configured deployment upon return of power.

PlanADCP: Windows-based software package allowing the user to configure, and evaluate the consequences of, a deployment command-set for an ADCP.

Profile: A series of regularly spaced depth cells in which the ADCP measures velocity along with several quality control parameters.

Pulse: A sound wave generated by a transducer.

Propagation Delay: The change in the travel time of sound between a source and scatterer, generally due to radial motion. As an example: if it takes longer for sound to reflect back from a scatterer than it did a short while ago (and the speed of sound has not changed), then the scatterer must be getting farther away.

------ Q ------

------ R ------

Radial Motion: Movement which alters the distance between source and scatterer.

Range: The maximum profile length of an ADCP, it depends on several factors (note that these factors are inter-related in a complex way, and the generalizations below are intended only as rules of thumb – use PlanADCP to check specific combinations):

1. Frequency: the lower the frequency, the longer the range.
2. Depth cell size: the larger the cell, the longer the range.
3. Mode of operation: mode 1 has the longest range.
4. Bandwidth: the narrower the bandwidth, the longer the range.
5. Concentration of scatterers: generally, the more scatterers, the longer the range.
6. Temperature: generally, the colder the water, the longer the range.

7. Salinity: generally, the fresher the water, the longer the range.

Range Gating: After sending a ping into the water, the ADCP transducers listen for returned signal. The time series of the returned signal is then broken into a sequence of time segments, or range gates. Each segment is equivalent to a depth cell, with the last segment coming from the farthest range from the ADCP.

RDI Tools: Software package containing all of the BB* programs (*BBTalk*, *BBList*, etc.) as well as several commonly used decoder files.

Reference Layer: In moving platform applications where the bottom is out of range, the vessel motion can be approximated by assuming the water is motionless at some point in the measured profile. This point is the reference layer.

Remotely Operated Vehicle (ROV): unmanned submersible controlled by an operator via a tethering cable.

Ringing: After transmission the ADCP electronics, transducer and immediate surrounding equipment (particularly in vessel mounted ADCPs) all require some finite time to dampen the transmit energy, during which time any signal return from scatterers will be contaminated.

Rio Grande ADCP: The model name for an ADCP optimally configured for measurement of river discharge. A distinguishing feature of Rio Grande ADCPs is that they are designed to operate from a 12 VDC power supply (all other ADCPs operate from 20 – 60 VDC).

Rosette: Oceanographic instrumentation package found on most research vessels. Rosettes are designed to be lowered to depths of interest while collecting data of various types. Most Lowered-ADCPs are mounted on rosettes.

ROV: Remotely Operated Vehicle

------ S ------

Scatterers: Small particles or plankton in the water which reflect sound waves.

Sea Chest: Cavity in the hull of a vessel to allow stream-lined, recessed mounting of equipment such as a Vessel Mount ADCP.

Sediview: Third party software designed to use ADCP echo intensity measurements and *in situ* sampling to obtain quantitative estimates of sediment concentration.

Self-Contained ADCP: An ADCP equipped with internal batteries and an internal recorder for autonomous operation.

Sentinel: The model name for a self-contained Workhorse ADCP.

Ship Coordinates: Profile data is reported in an orthogonal coordinate frame as referenced to the ship (if beam 3 is forward then ship coordinates are the same as instrument coordinates).

Shiptrack: DOS program to integrate and display Navigator data.

Sidelobes: Peaks in sound intensity generated by a transducer found to the side of the main lobe.

Sidelobe Contamination: This only need be considered when operating an ADCP near a boundary (e.g. in shallow water). The beam angle of the main lobe of an ADCP transducer is 20 or 30º off the vertical, which means that the distance to the boundary along the ADCP centerline is shorter than the distance to the boundary along a beam. Because most boundaries will reflect very strongly (much more strongly than the scatterers), sidelobe energy can travel the shorter path directly to the surface and thereby include the “velocity” of the boundary with the velocity measurements taken along the beams at any longer distance. This potential for interference depends strictly on the beam angle. An ADCP with a 20º beam angle has the potential for sidelobe contamination at (distance to the boundary)*cos(20º), or equivalently, the last 6% of the profile. Note: Sidelobe contamination is not relevant for DVLs, which specifically look for the bottom.

Software Break: When using radio or acoustic telemetry, it is usually not possible to send a break signal. Under these circumstances an ADCP can be configured to recognize a series of keystrokes (i.e. = = =) as a break.

Source: Originator of sound of known frequency, here typically the transducer of an ADCP.

StreamPro: Model name for ADCP designed for discharge measurement in shallow waterways.

------ *T* ------

Top Discharge: When using an ADCP to measure river discharge, it is not possible to measure all the way to the surface (due to the blank zone and to the need to mount the transducers at sufficient depth to remain submerged with no air entraining past the transducers). In order to get an accurate approximation of the total discharge, the flow in this area must be estimated and included, usually by extrapolating the measured velocities to the surface.

Transducer: A device to convert electrical energy into sound waves, and vice versa.

------ U ------

Unmanned Underwater Vehicle (UUV): Generic term referring to both AUVs and ROVs.

UUV: Unmanned Underwater Vehicle

------ V ------

Vessel Mount: An ADCP mounted to the hull of a vessel, typically in a sea chest, and having inputs from the vessel's navigation equipment.

VM-DAS: Windows-based data acquisition package for vessel mount ADCPs. This package includes the ability to incorporate the ship's navigation equipment.

------ W ------

Wavelength: The distance between successive wave crests in a sound wave.

WinADCP: Windows-based post-processing package for ADCP data.

WinH-ADCP: Windows-based data acquisition and playback package for Horizontal ADCPs.

WinRiver: Windows-based software package for real time ADCP data gathering. It is designed primarily for measurement of river discharge and allows integration of the platform's navigation equipment. It also converts echo intensity measurements to qualitative estimates of backscatter.

WinSC: Windows-based software package for self-contained ADCPs includes configuring, testing, data recovery and viewing options.

Workhorse ADCP: The generic model name for all of the non-phased array broadband ADCPs currently produced by RDI.

------ X ------

Xdcr: A common abbreviation for transducer.

------ Y ------

------ Z ------

ZedHed: RDI trade name for a transducer designed to minimize ringing.

NOTES

NOTES