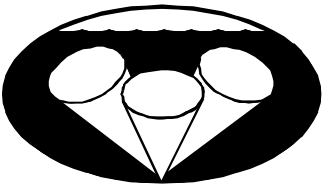

RD Instruments

Acoustic Doppler Current Profilers

Workhorse
Sentinel User's Guide

For Self-Contained Data Collection

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1. Before You Start

This booklet is a short guideline for using the RD Instruments Workhorse Sentinel ADCP for self-contained deployments. The Workhorse Sentinel is one of the Workhorse series of BroadBand Acoustic Doppler Current Profilers.

This short guide offers pointers, figures, and suggestions, to make your deployment more reliable and effective. It will help you understand the organization and philosophy of our software. It will not explain things that you can easily figure out on your own. We hope you find your time reading this guide to be well spent!

The Workhorse software includes modules for both the Sentinel and the direct-reading Workhorse Monitor. Modules specific to the Monitor's real-time applications can also be used in many applications with the Sentinel. Read for the Workhorse Monitor User's Guide for more information on real-time data collection.

Give the transducer faces special care. Any damage to the polyurethane surface could cause the instrument to fail. Consult the Technical Manual for tips to care for your instrument.

1.1 Unpacking

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

1.2 Connection.

Figure 1 illustrates how to connect the Workhorse cables and adapters on your workbench. The internal battery plugs into a connector on the top circuit board. RDI ships the battery inside the Workhorse, but the battery cable is not connected.

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

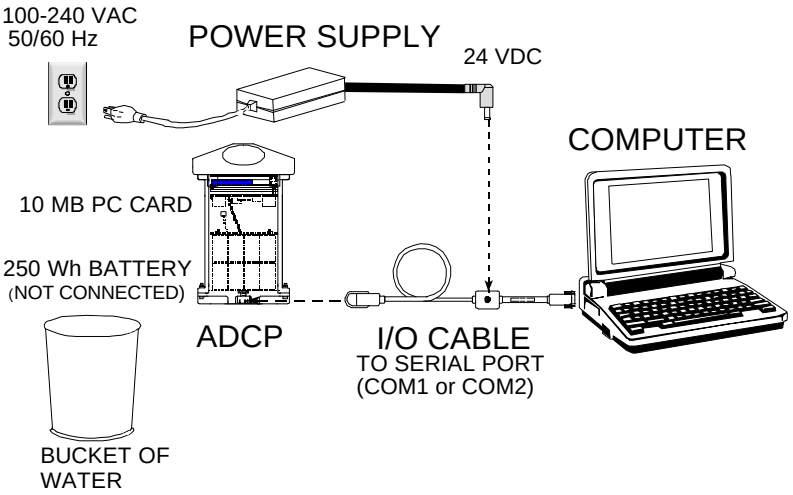

Figure 1. Workhorse Sentinel Connections

If you connect your battery internally, you do not need to connect the AC power supply.

1.3 Installing and Using the Software

Instructions for starting the installation routine are on the floppy disk label. Before running *INSTALL*, assemble and connect the Workhorse, cable, and AC supply (see Figure 1). The installation routine needs the name of the directory that will hold the programs. Unless you prefer a different name, we suggest C:\WH. In the future, change into this directory before you run the Workhorse software.

INSTALL first creates a directory and copies the software into the directory (uncompressing files automatically). *INSTALL* then runs a batch file called *CONNECT*. This batch file connects to the Workhorse, configures the software for the serial port connected to the Workhorse, and runs a simple test so that you know the Workhorse works.

1.3.1 General Guidelines Regarding Software

- Requires 386 or better processor
- All programs run under DOS.
- All assume you have a color VGA display but each can also run in mono mode.
- Each program has an associated text file that documents the program.
- Each program has a help screen.

The following command line parameters usually apply (when appropriate)

- /? shows you a help screen (except *BBLIST* ?)
- /M displays in monochrome
- /50 displays using 50-line VGA mode
- /Bnnn sets the baud rate
- /COMn sets the expected COM port

1.3.2 Workhorse Software Philosophy

Self-contained data collection involves a series of independent steps, each with associated software.

- Test your Workhorse (*TESTADCP*)
- Plan your deployment (*PLAN*)
- Transfer your 'plan' into the Workhorse and start data collection (*DEPLOY*)
- Transfer the data from the Workhorse's PC Card recorder to your computer (*RECOVER*)
- Verify data integrity (*CHECKDAT*)
- When you are satisfied that your recorded data is safely backed up, erase the Workhorse PC Card recorder (*ERASEMEM*)
- Display and process your data (*QUIKLOOK*, *WATCH* and *BBLIST*)

There are several utility programs to help use the Workhorse, each with associated software.

- *RESET* searches for the Workhorse on COM1 and COM2, configures the serial port connected to the Workhorse, but does not run any tests.
- *CONNECT* calls *RESET* and runs a simple diagnostic test to verify the Workhorse's operation.
- *MEM-INFO* displays the amount of space used and free on the PC Card recorder.
- *FAST-REC* starts *RECOVER* using the fastest baud rate possible.

The Workhorse software is designed to allow you to set up your Workhorse to get the best possible data without having to understand and use Workhorse commands. *PLAN* creates *deployment planning files* (also called command files). These files hold the commands that will be sent to the Workhorse to start the deployment. Curious users may look at the deployment planning files and read about each command in the technical manual. However, few users, whether novice or expert, have reason to change the commands.

1.4 File Naming Conventions

The Workhorse software also gives you a complete record of information that might help you understand your data. This information is stored in text files on the PC Card recorder of a Workhorse when it is prepared for a self-contained deployment.

When you recover your data, the files are transferred to your computer along with your recorded data. Another similar file is created during data recovery. To help you associate these files with your data, they use the same deployment name. Where shown, substitute your 5-character name for ABCDE. You will not normally need these files, but they become important if you have a problem or a question about your data. Be careful not to lose these files!

- TESTADCP.DAT - Results from *TESTADCP* are appended to this file.
- ABCDE.TLG - *DEPLOY* copies the results from *TESTADCP* into this file. *DEPLOY* assumes that the information in TESTADCP.DAT applies to the instrument you are presently preparing for deployment.
- ABCDE.CMD - Command file created by *PLAN*.
- ABCDE.DLG - Deployment log file created by *DEPLOY*. This file contains all of the commands sent to the Workhorse (from ABCDE.CMD) and the Workhorse's system information before deployment.
- ABCDExxx.LOG - Deployment log file (on PC Card recorder, where xxx = deployment number).
- ABCDExxx.nnn - Raw data file. Where xxx = deployment number and nnn = recorder card number (incremented when the card is full .000 = card one, .001 = card two). Raw data files will always be paired with a deployment log file (ABCDExxx.LOG).
- RECOVER.LOG - Recovery log file created by *RECOVER*. The data will be copied to the ABCDE directory on your hard drive. This file contains all of the commands sent to the Workhorse (from ABCDE.CMD) and the Workhorse's system information after deployment.

2. Serial Communication

The standard communications settings are 9600 baud, no parity, 8 data bits and 1 stop bit. Self-contained applications receive no benefit from setting a faster baud rate (*RECOVER* automatically changes to a higher baud rate when transferring data from the recorder to your computer).

You can set the Workhorse for baud rates other than 9600 baud. If you make the new baud rates permanent, most of the software modules will search for the correct settings, (and will try COM2 but not COM3 or COM4). If you tell the software these settings, you will save time required for searching. If you have trouble connecting to the Workhorse, try using *CONNECT* which searches for the Workhorse's current serial port and baud rate and resets the Workhorse to 9600 baud.

RS422. The Workhorse Sentinel is normally set for RS232, but it can be changed to RS422 by changing a switch setting. The switch is in plain view on the top circuit board, a centimeter or so from the fuse. Its settings are plainly marked on all but the earliest production systems. If the serial protocol is set for RS422 and your computer expects RS232, you will need an RS232-RS422 adapter between the Workhorse cable and your computer. This user's guide assumes that you use RS232. There is no reason to use RS422 for self-contained operation.

3. What if the Workhorse Does Not Respond

If your Workhorse does not respond, check the serial port, cables, AC power, and battery connection. Try running *CONNECT*. If necessary, refer to the trouble- shooting procedure in the technical manual.

If you are running Windows™, try running the Workhorse software from DOS. Try booting your computer with a DOS floppy containing no autoexec.bat or config.sys files.

Workhorse Sentinels are shipped from the factory with one battery inside the pressure case, but the battery is not connected. Be sure to reconnect the battery before deployment!

4. Batteries and Power

4.1 AC Adapter

The AC Adapter runs on any standard AC power and supplies 24 VDC to run the Workhorse when the batteries are not connected. Substitute your own power supply with a voltage of 45-60 VDC to override the 42 VDC alkaline battery packs.

> **NOTE**
>
> *The 24 VDC AC adapter does not override the battery voltage!*

All Workhorse tests and operations work equally well using either internal battery packs or the AC power supply. If you collect data using the AC adapter, the profiling range is reduced compared with standard battery voltage.

4.2 Reusing Alkaline Batteries

Because many deployments will use only a fraction of the capacity of a single battery pack, you may wish to reuse your battery packs. With experience you should be able to reuse batteries successfully, but keep in mind the following:

- Standard Workhorse battery packs hold 28 'D-cell' alkaline batteries with a voltage, when new, of approximately 42 VDC.
- Test the battery pack's voltage under load at room temperature (we suggest a 750 ohm, 10 watt resistor).
- When the capacity of a battery pack is 50% used, the voltage (under load) falls to approximately 32-35 volts. However, keep in mind that this voltage is not an accurate predictor of remaining capacity.
- Battery packs differ from one to another.
- If your deployment is important, weigh the cost of a new battery pack against the risk of lost data.

4.3 Alkaline Battery Pack Capacity

RDI specifies its battery packs conservatively to have 250 watt-hours (Wh) of usable energy at 0°C. Our tests suggest that actual capacity could be higher, perhaps as high as 400 Wh. We recommend that you plan your deployments based on 250 Wh capacity until we all get more experience with these battery packs.

4.4 Bench-top Battery Power Requirements

While the Workhorse is awake and responding to commands, it consumes approximately 2.2 watts. A single internal battery pack supplies this power level for about 5 days. When the Workhorse is asleep, it consumes less than 1 mw. A standard battery pack supplies sleep power for years. At every opportunity, the Workhorse will "sleep" to conserve power while deployed.

4.5 Operation Modes

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

In the Command Mode

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

- If the ADCP receives a BREAK, it will go to the command prompt and wait for a command. The 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 ADCP will go to sleep.
- If the ADCP receives a CS-command, it will go into the ping mode and begin pinging. If a TF-command was sent prior to the CS-command, then the ADCP will go to sleep until the TF time occurs.
- If the ADCP does a COLD wakeup (i.e. an unknown state), it will go to the command prompt.
- If the 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 ADCP goes back to sleep.

In the Ping Mode

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

- If the ADCP receives a BREAK, it will go to the command prompt, but stays in the ping mode. If a valid command is received, the 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 ADCP will resume pinging.
- If you press the reset switch, if an alarm is currently set for the next ping, the 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 ADCP will go to sleep until the TF time occurs.
- If the 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 ADCP will go to sleep until the TF time occurs if the TF time is valid (i.e., not in the past).
- If the 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 ADCP goes back to sleep and wait for the alarm. If no alarm is set, the ADCP will resume pinging immediately, or wait for the TF time (if valid), and then start pinging.

5. Running Internal Tests

5.1 Software for Testing Your Workhorse

TESTADCP is a batch file that starts *BBTALK* using a script file. The program wakes up the Workhorse and turns on data logging (records the results) to the file TESTADCP.DAT. We recommend that you save this file by renaming them and moving them to another directory.

TESTADCP runs the following direct commands and displays the result of each test.

- PA - System test (The Workhorse must be in enough water to cover the transducer face during this test, or several tests will fail. Running this test with the Workhorse out of water will cause the Workhorse no harm).
- PC2 - Display heading, pitch, and roll (sensor test).
- RR - Show recorder directory and free space.
- PC1 - Beam continuity test.
- Allows you to enter any other direct commands.

RESET resets your Workhorse to its factory defaults (including 9600 baud), no matter how it is configured nor which baud rate it is set for. It will try both COM1 and COM2 and baud rates from 1200 to 115200. You can tell *RESET* the current baud rate and COM port to save you the time needed to search for the correct combination. If you wish, you could use *RESET* to set a baud rate other than 9600, to set the Workhorse time to the computer time or to get information about the Workhorse such as the amount of recorded data.

BBTALK is a general-purpose utility that allows you to talk directly to the Workhorse (you can see the Workhorse's help menu by pressing the end key to send a break followed by the ? key). You can use *BBTALK* to set up the instrument directly, implement built-in tests, and even to collect and record binary data. It is worthwhile to explore *BBTALK's* command scripting capability. Scripting is a powerful way to automate tasks including starting data collection. The Workhorse software contains several script files each documented with comments.

You can use *BBTALK* to reconfigure the software for a different serial port or different baud rate. After you start *BBTALK*, use the F5 function key to get a menu that lets you change to the Workhorse's port or baud rate. After you leave the serial menu, press the F6 function key to save the values. The other software will use the saved values when it connects to the Workhorse.

5.2 Running Tests and Interpreting Results

Start tests by running *TESTADCP*, and then enter commands directly to the Workhorse.

Table 1 lists the tests you can run, gives you guidelines for running the tests, and tells you what the results mean. When you are done, rename the log file (TESTADCP.DAT) and save it for future reference.

Table 1. Workhorse ADCP tests.

Test	Guidelines	Results
PA	Extensive pre-deployment test that tests the signal path and all major signal processing subsystems. This test may not pass unless the Workhorse transducer face is immersed water.	All tests must pass.
PC1	Beam continuity test. Follow instructions to rub each beam in turn to generate a noise signal the Workhorse uses to verify the transducer beam is connected and operational.	All beams must pass.
PC2	Continuously updates sensor display. Rotate and tilt Workhorse and watch the readings on the display change.	Satisfy yourself that the readings make sense.
RR	Show recorder file directory.	Should see a directory listing of all files on the recorder and the amount of free space on the recorder.

6. Compass Calibration

RDI's compass can be calibrated in the field without additional equipment because its two-axis tilt sensor and three-axis flux gate compass measure more information than it needs. The additional, redundant information is sufficient to enable internal compass calibration. We recommend against calibration on a ship. The ship's motion and magnetic fields from the hull and engine will likely prevent successful calibration.

Keep in mind that if you remove and reinstall the pressure housing, you must keep the same battery orientation relative to the compass or you will have to recalibrate the compass. You will find arrows on the transducer, end cap and pressure case flanges that indicate their proper orientations.

6.1 Reasons for Compass Calibration

The main reason for compass calibration is battery replacement. Each new battery carries a different magnetic signature. The compass calibration algorithm corrects for the distortions caused by the battery to give you an accurate measurement.

If you think your mounting fixture or frame has some magnetic field or magnetic permeability, you should run the compass verification procedure and, if necessary, the compass calibration procedure. You must verify and/or calibrate the Workhorse inside its fixture. Depending on the strength and complexity of the fixture's field, the calibration procedure may be able to correct for it.

6.2 Batteries and Magnetic Fields

Alkaline batteries have a magnetic signature that comes mostly from the nickel in their cases. RDI's alkaline battery packs are degaussed to minimize compass errors. Even degaussed batteries have a magnetic signature that includes a residual magnetic field plus magnetic permeability. This signature distorts the earth's magnetic field. RDI has developed a simple compass calibration procedure that allows you easily to measure and correct for the distortions caused by your battery pack. When you install new battery packs, please pay attention to the following:

- Use degaussed battery packs.
- After you install a new battery pack, recalibrate the compass.
- If you want to avoid all trouble with magnetic fields from battery packs, use an external battery case and keep it at least 30-cm away from the Workhorse.

6.3 Preparing for calibration

Compass calibration and verification require rotating the Workhorse on a non-magnetic surface. While the ideal place to do this is on a non-magnetic rotating table, these procedures require nothing so complicated. Instead, a piece of strong cardboard on top of a smooth wooden (read: non-magnetic) table will do nicely. Place the Workhorse gently on the cardboard and rotate it by turning the cardboard. This way you will not scratch the Workhorse.

Connect the Workhorse to power and a computer as in Figure 1. You will need no other equipment. These tests require that you send commands directly to the Workhorse using *TESTADCP* (which runs *BBTALK*, wakes up the Workhorse and starts logging to the file TESTADCP.DAT). Be sure to save the log file when you are done.

If you will deploy your Workhorse looking up, calibrate it looking up. If you will deploy it looking down, calibrate it looking down.

6.4 Compass Calibration Verification

Compass calibration verification is an automated built-in test that measures how well the compass is calibrated. Start the test with the AX command and follow the instructions. The Workhorse can be vertical (it can rest on its end cap), or it can be tilted (it could rest on a transducer face). Whatever its tilt, the tilt must remain constant as you rotate the Workhorse. The procedure measures compass parameters at every 5° of rotation for a full 360° rotation. The screen display tells you which directions it still needs. Rotate the Workhorse smoothly and slowly. When it has collected data for all required directions, the Workhorse computes and displays the results. Pay particular attention to the Overall Error.

If you want to verify the calibration the good old-fashioned way, use the PC2 command to obtain a continuously-updating display of the current heading and tilt measurements. The PC2 compass heading is reference to beam-3. You can use this output while turning the Workhorse on a rotating table to compare Workhorse compass readings against the table direction.

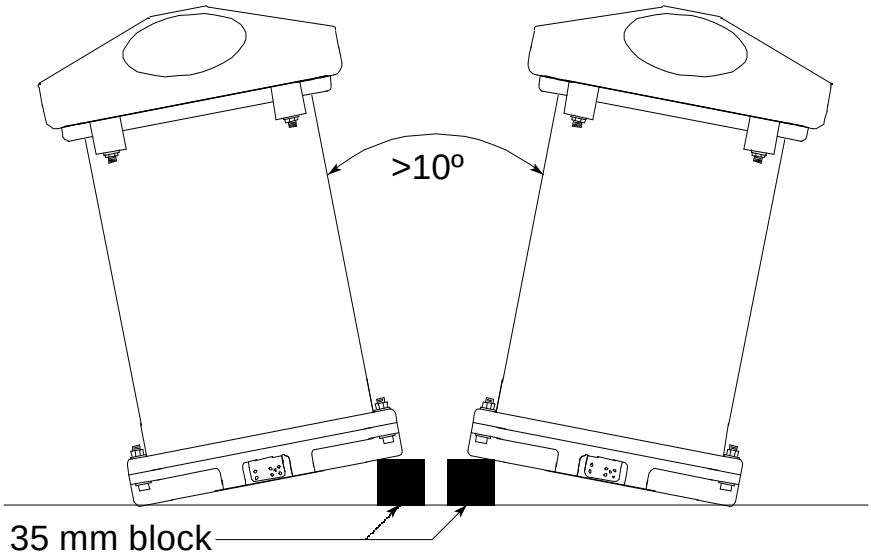

Figure 2. Compass Alignment.

Change the Workhorse orientation at least 10° between the first and second calibration rotations.

6.5 Compass Calibration Procedure

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

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

a. Start the test with the AF-command and choose the calibration type**.**

b. When prompted, rotate the Workhorse slowly 360°.

c. The second rotation requires the Workhorse to be tilted on an adjacent beam. Follow the on-screen instructions to orient the unit correctly. Tilt an upward-looking Workhorse with a block under one side of the end cap. A 35-mm block gives you an 11º tilt. When prompted, rotate the Workhorse slowly 360°.

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

6.5.1 Return to Factory Calibration

If the calibration procedure is not successful, return your Workhorse 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.

6.5.2 Read compass calibration matrix

The AD command gives you a listing of the compass calibration matrix. This information is primarily useful for future reference in case you have trouble with data.

6.6 Internal Pressure Sensor

If you have the optional pressure sensor installed in your ADCP, use the AZ-command to zero out the pressure sensor at the deployment site. .

a. Connect and apply power to the system as described in Chapter 1.

b. Start *BBTALK* and wakeup the ADCP (press the **END** key).

c. Type **AZ**.

d. Press **ALT-X** to exit *BBTALK*.

7. Deployment Software

PLAN lets you see the consequences of different ways of using your Workhorse for deployments. Once you decide on the optimum deployment setup, it creates a *Deployment Planning File* with the commands you will later use to set up the Workhorse for deployment. As long as you do not manually change the Deployment Planning File, you can reload and change the file as often as you want.

PLAN assumes that the Workhorse is set to its factory defaults (it includes commands in the Deployment Planning File that put the Workhorse back to the factory defaults), and it adjusts only a subset of the available commands. Expert users may add other commands to the Deployment Planning File, but *PLAN* will not read Deployment Planning Files that contain these non-standard commands.

DEPLOY sets up the Workhorse by sending the commands from the Deployment Planning File to the Workhorse. *DEPLOY* checks your battery voltage, that your deployment planning file contains the command to record data internally and that your Workhorse PC Card recorder is ready for recording.

DEPLOY is actually a batch file that calls the general-purpose initialization program, *INITADCP*. Before you run *DEPLOY*, set the computer time precisely to the time you want to record with your data. *DEPLOY* uses the computer time to set the Workhorse time. If you delay start up for more than a day, it asks you to verify that the delayed startup time is correct. If the Workhorse responds to a command in the Deployment Planning File with an error, *DEPLOY* tells you which command caused the problem and then terminates.

DEPLOY creates a deployment log file documenting the commands used to set up the Workhorse, information about the Workhorse itself such as the compass calibration matrix, and a log of the deployment process. This file is given the deployment name with the extension .DLG. The deployment log file is recorded to the Workhorse PC Card recorder and renamed ABCDExxx.LOG (substitute your 5-character name for ABCDE). *DEPLOY* creates a directory on the PC Card recorder using the deployment name. It then moves the deployment log file, the deployment planning file and (if one exists) the TESTADCP.DAT file into this directory (*.TLG). Be sure to save these files because they contain important information about your deployment.

8. Deployment Guide

Use the following steps and the Quick Reference card to setup the Workhorse for a deployment.

8.1 Prepare the ADCP for Deployment

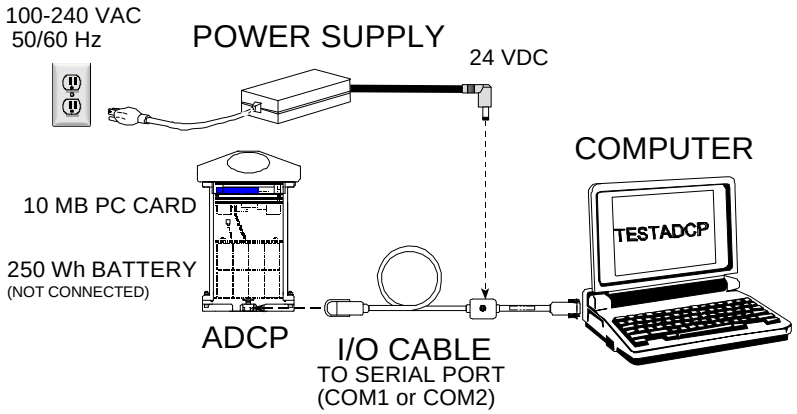

Figure 3. Test the ADCP

Things to remember while preparing the ADCP.

- Test the ADCP using *TESTADCP*. Some tests will fail if the ADCP is not placed in water while the tests are being run.
- Use the AC power supply while testing the ADCP. Save the batteries for deployments.
- Use the Self-Contained Deployment Checklist (located on the Quick Reference card) to verify that the ADCP is ready for the deployment.
- *Desiccant* is essential in deployments with plastic pressure cases. The factory-supplied desiccant lasts a year at specified Workhorse deployment depths and temperatures. Remember that desiccant rapidly absorbs moisture from normal room air.
- Calibrate the compass (see Chapter 4 in the Workhorse Technical Manual).
- If you have the optional internal pressure sensor, use the AZ-command to zero it at the deployment site.

8.2 Plan the Deployment

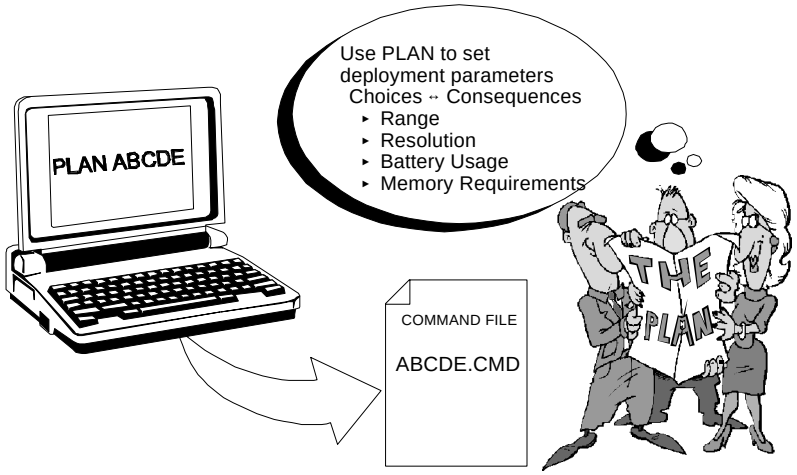

Figure 4. Plan the Deployment

Things to remember while using *PLAN*.

- *Deployment names*. Choose and use Deployment Names carefully: they help you identify and organize all the data and log files associated with each deployment. Remember that the name must be exactly five characters long (substitute your 5-character name for ABCDE).
- *Workhorse time* is set from your computer's time. Be sure your computer is set to the time appropriate for your deployments before you use *DEPLOY* to start data collection.
- *Uniform sample times*. Start sample intervals on the minute by using a delayed start up. Instead of having your 10-minute sample intervals start at 15:36:47, delay startup a few minutes to have samples start at 15:40:00.
- *PLAN* allows you to make choices and see the consequences for the *entire* deployment.

8.3 Send the Deployment Commands

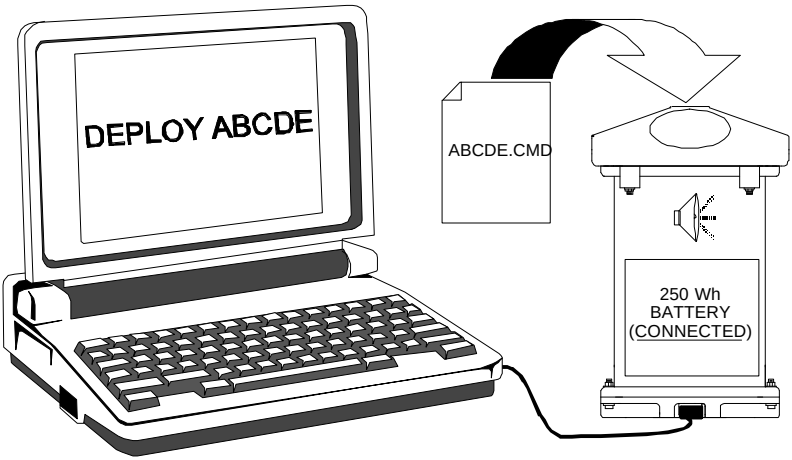

Figure 5. Send the Deployment Commands

Things to remember while using *DEPLOY*.

- The Workhorse must be using battery power and be sealed, ready for deployment.
- *Ping beeps*. Whenever the Workhorse pings, an internal beeper makes an audible beep. The beep consumes negligible energy and tells you the Workhorse is pinging.
- View the ABCDE.DLG file. This file shows all of the commands sent to the ADCP and the ADCP's response.
- Disconnect the I/O cable and install the dummy plug.

8.4 Deploy and Recover the ADCP

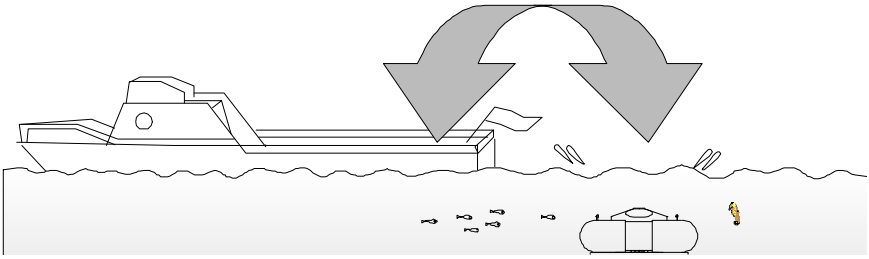

Figure 6. Deploy and Recover the ADCP

Things to remember while deploying the ADCP.

- Data files are ABCDE000.LOG (log file) and ABCDE000.000 (raw data) (substitute your 5-character name for ABCDE).
- *Tilts*. The Workhorse corrects data for tilts as large as 15°, but tilts reduce the effective range and increase the depth of surface contamination.
- *Anti-fouling paint*. You are free to use any anti-fouling paint or other anti-fouling material you wish over any surface of the Workhorse. However, you should consider the following:
    1. Ensure that your coating can be used safely on plastic in general and polyurethane specifically.
    2. Apply it thinly and evenly to the transducer faces.
    3. Poorly applied coatings on the transducer could adversely affect instrument performance.
- *Magnetic material*. Keep the Workhorse's compass away from magnetic material when you deploy the instrument. Check for magnetic fields by smoothly moving a compass around and near the Workhorse and its mounting frame.

8.5 Recover the Data

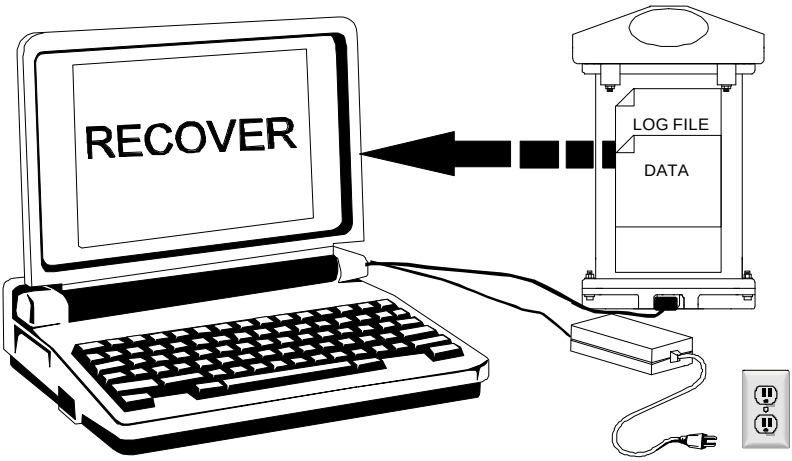

Figure 7. Recover the Data

Depending on the amount of recorded data, you can view your data within an hour of recovering the Workhorse from the water. RDI has software modules to recover the data from the recorder, check its integrity, list it and convert it into an ASCII file suitable for importing into a spreadsheet or other analysis program.

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

However, be aware that because each computer uses different PC Card drivers, installing PC Card drivers on a laptop is not necessarily easy. If you cannot read the memory cards in your computer, you can use *RECOVER* to read the data through the Workhorse's serial port. RDI can supply or recommend laptops that can read our PC Card flash cards.

NOTE

Insert flash cards gently: they slide in easily when properly inserted. Cards lock in place when they are fully inserted.

Remove the flash cards by pushing a button on one side of the PC Card. PC cards are installed with the label side toward the face of the transducer.

RECOVER reads data files from the Workhorse PC Card recorder via the serial port and saves the data to the PC hard disk. It uses the Workhorse's current Deployment Name to create a new directory for the data on the computer's hard drive. You can specify a different destination directory when you run *RECOVER*. When *RECOVER* is finished, you will find on your PC all the same files that are on your Workhorse, and in the exact same format. *RECOVER* transfers all data files even if you have recorded more than one deployment.

RECOVER switches the baud rate from whatever baud the Workhorse is set for to 57,600. You can set *RECOVER* to use 115,200 baud, but be prepared to switch to lower baud rates if you have trouble transferring data. Using 115,200 baud will download 10 MB of data in approximately 30 minutes. *RECOVER* transfers data using an error-correcting protocol (YMODEM), so you can be confident about the integrity of the data files.

RECOVER creates a log file of the recovery process and saves it in the directory in which it puts the current data. The file is named RECOVER.LOG.

8.6 Verify and View the Data

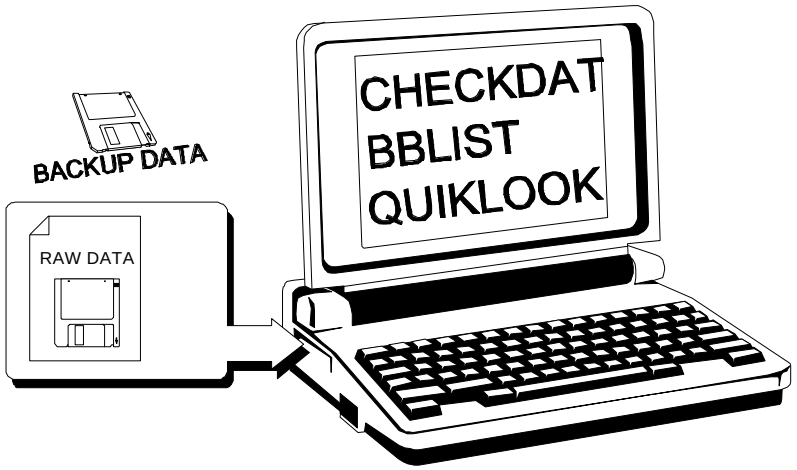

Figure 8. Verify and View the Data

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

> **NOTE**
>
> *Check your data carefully and back it up before erasing the Workhorse's data recorder.*

BBLIST displays your data in a tabular format in a variety or units and converts the data into an ASCII format you create. People often expect the ASCII conversion process to be complicated and time-consuming. In fact it is easy to use, intuitive and rapid. When you are ready, you should just go into the Convert menu and try it out.

WATCH plays back data in a variety of formats (i.e. profiles, time series, and color contour plots). The easiest way to use *WATCH*, especially when you are new to it, is to run *QUIKLOOK*. *WATCH* allows you to change displays and to save the overall screen design in a configuration file for future viewing.

8.7 Erase the Recorder

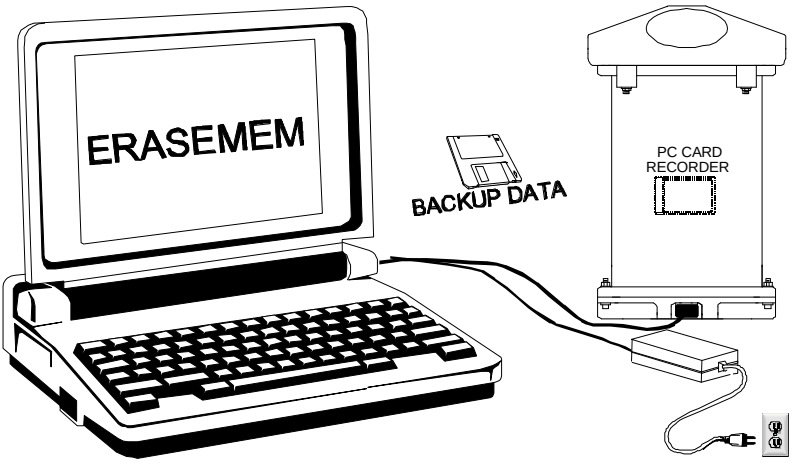

Figure 9. Erase the Recorder

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

9. Backing Up Data

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

- Use PKZIP (available on RDI's BBS) to condense the files and store them on floppy disks. PKZIP has the ability to store large files (span) onto several disks.
- Remove the original PC Card containing data and store it in a safe place. Install another PC Card in its place.
- Backup your data to a tape drive or other device.
- Use the DOS backup command.
- Download the data to another computer.

10. Time, Space and Velocity

10.1 'Where' was the Data?

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

10.2 'When' was the Data?

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

10.3 'What' is the Data?

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

11. A Few Principles of Operation

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

- Horizontal velocity measurement accuracy is unaffected by vertical stratification.
- Stratification has negligible affect on the ability of the Workhorse to penetrate through the water; concentration of suspended particles is the main factor influencing profiling range.
- Workhorse measurements are automatically corrected for tilts up to In addition to correcting for the beam pointing angles, the Workhorse maps depth cells to other cells at the same depth.

- If you want to make measurements near the surface from a bottom-mounted Workhorse, you should minimize the tilt.
- Depth cells are most sensitive to velocities at the center of the depth cell and less sensitive at the top and bottom. This sensitivity is reflected by what we call a 'triangular weighting function'. The details of this weighting function are rarely important for interpretation and use of your data.
- The actual maximum range can be different from the range predicted in *PLAN*. *PLAN* corrects for range variations caused by temperature and salinity, but it assumes typical scattering conditions. Weak backscatter can sometimes reduce range by a factor of two or more.
- In self-contained deployments, the maximum profiling range decreases with time as the battery voltage falls. This is because transmit power depends on battery voltage. Transmit power is optimized for about 32 volts. RDI's alkaline battery packs start at 42 VDC, but spend most of their useful lives within a few volts of 32 VDC.

12. Technical Support

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

- Phone: 619-693-1178
- Fax: 619-578-4016
- Internet: rdifs@rdinstruments.com
- FTP: ftp.cts.com/pub/rdifs (contains our latest field service bulletins)

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.

- Phone: 619-693-1178
- Fax: 619-695-1459
- Internet: rdi@rdinstruments.com (we read our mail every work day at around 0800 local time).