WorkHorse
Test Guide

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RD Instruments
Acoustic Doppler Solutions

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WorkHorse Test Guide

1 Introduction

This chapter explains how to test the Workhorse using the *WinSC* and *BBTalk* programs. These tests thoroughly check the Workhorse in a laboratory environment, but are no substitute for a practice deployment. You should test the Workhorse:

- When you first receive the Workhorse.
- Before each deployment or every six months.
- When you suspect instrument problems.
- After each deployment.

These test procedures assume all equipment is working. The tests can help you isolate problems to a major functional area of the Workhorse. For troubleshooting information, see the Troubleshooting Guide.

NOTE. For stationary deployments, the *WinSC* or *BBTalk* tests are the only tests required to verify the ADCP is operating correctly. When the ADCP is mounted to a moving vessel, use the Dock Side tests and the Sea Acceptance tests.

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.

2 Testing the WorkHorse with *WinSC*

Use the following steps to test the ADCP.

NOTE. For stationary deployments, the *WinSC* or *BBTalk* tests are the only tests required to verify the ADCP is operating correctly. When the ADCP is mounted to a moving vessel, use the Dock Side test and the Sea Acceptance tests.

a. Connect and power up the ADCP as shown in the appropriate ADCP User's Guide.

b. Start *WinSC* (for help on using *WinSC*, see the *WinSC* User's Guide).

c. At the **Welcome** screen, click **Test an ADCP**. Click **OK**. This will run the pre-deployment tests Deploy?, System?, TS?, PS0, PA, PC2, RS, and PC1-commands. The results of the tests will be printed to the screen and saved to the log file (*.scl).

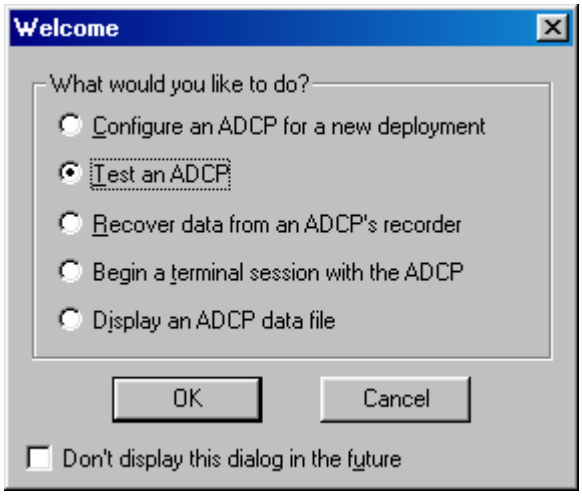

Figure 1. Using WinSC to Test an ADCP

3 Testing the WorkHorse with *BBTalk*

Use the following steps to test the ADCP.

NOTE. For stationary deployments, the *WinSC* or *BBTalk* tests are the only tests required to verify the ADCP is operating correctly. When the ADCP is mounted to a moving vessel, use the Dock Side test and the Sea Acceptance tests.

a. Interconnect and apply power to the system as described in the appropriate ADCP User's Guide.

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

c. Press **<F2>** and run the script file TestWH.txt. The TestWH.txt script file runs PS0, PS3, PA, PC2, and the PC1 tests. The results of the tests will be printed to the screen and saved to the log file WH_RSLTS.txt. The WH_RSLTS.txt file will be created in the same directory that *BBTalk* is running from.

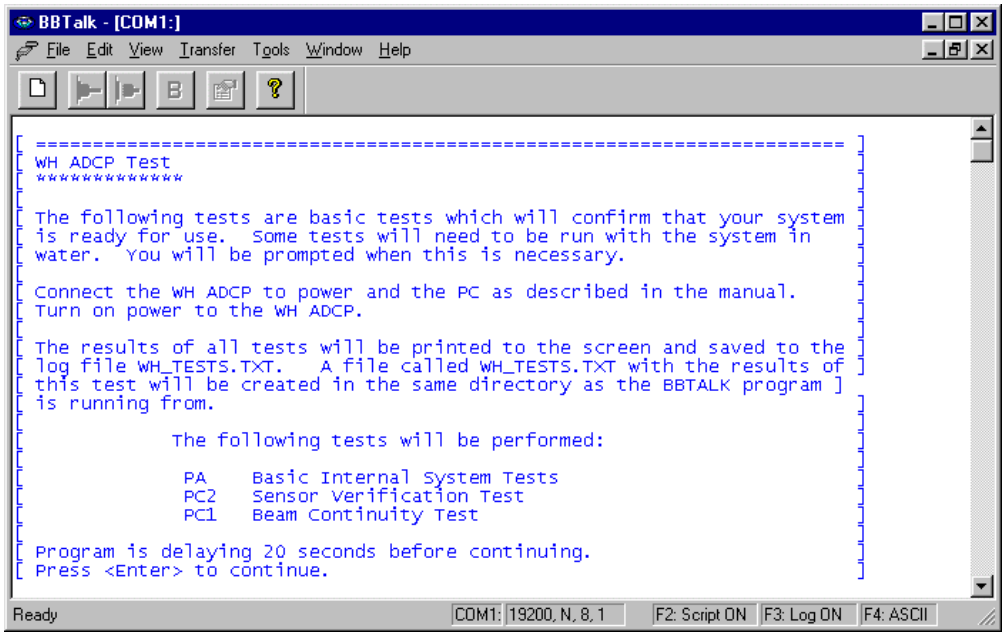

Figure 2. Using BBTalk to Test an ADCP

4 Test Results

This section shows an example of the test result printout after running the *WinSC* tests or the *BBTalk* script file TestWH.txt.

NOTE. The built-in tests require you to immerse the transducer faces in water. If you do not, some of the tests may fail. Running the tests in air will not harm the ADCP.

4.1 Deploy Commands List

WinSC sends the ADCP the Deploy? command. This will show a list of the deployment commands and their current setting. For example;

```
deploy?
Deployment Commands:
RE ------------------------ Recorder ErAsE
RN ------------------------ Set Deployment Name

WD = 111 100 000 --------- Data Out (Vel,Cor,Amp; PG,St,P0; P1,P2,P3)
WF = 0088 ---------------- Blank After Transmit (cm)
WN = 030 ----------------- Number of depth cells (1-128)
WP = 00045 --------------- Pings per Ensemble (0-16384)
WS = 0200 ---------------- Depth Cell Size (cm)
```

```
WV = 175 ----------------- Mode 1 Ambiguity Vel (cm/s radial)

BP = 000 ----------------- Bottom Track Pings per Ensemble

TE = 01:00:00.00 --------- Time per Ensemble (hrs:min:sec.sec/100)
TF = **/**/**,**:**:** --- Time of First Ping (yr/mon/day,hour:min:sec)
TP = 01:20.00 ------------ Time per Ping (min:sec.sec/100)
TS = 94/01/30,00:11:17 --- Time Set (yr/mon/day,hour:min:sec)

EA = +00000 -------------- Heading Alignment (1/100 deg)
EB = +00000 -------------- Heading Bias (1/100 deg)
ED = 00000 --------------- Transducer Depth (0 - 65535 dm)
ES = 35 ------------------ Salinity (0-40 pp thousand)
EX = 11111 --------------- Coord Transform (Xform: Type,Tilts,3 Bm,Map)
EZ = 1111101 ------------- Sensor Source (C,D,H,P,R,S,T)

CF = 11111 --------------- Flow Ctrl (EnsCyc;PngCyc;Binry;Ser;Rec)
CK ----------------------- Keep Parameters as USER Defaults
CR # --------------------- Retrieve Parameters (0 = USER, 1 = FACTORY)
CS ----------------------- Start Deployment
```

4.2 System Commands List

WinSC sends the ADCP the System? command. This will show a list of the system commands and their current setting. For example;

```
>system?
System Control, Data Recovery and Testing Commands:
AC ----------------------- Output Active Fluxgate & Tilt Calibration data
AF ----------------------- Field calibrate to remove hard/soft iron error
AR ----------------------- Restore factory fluxgate calibration data
AX ----------------------- Examine compass performance
AZ ----------------------- Zero pressure reading

CB = 411 ----------------- Serial Port Control (Baud; Par; Stop)
CP # --------------------- Polled Mode (0 = NORMAL, 1 = POLLED)
CZ  ---------------------- Power Down Instrument

FC ----------------------- Clear Fault Log
FD ----------------------- Display Fault Log

OL ----------------------- Display Features List

PA ----------------------- Pre-Deployment Tests
PC1 ---------------------- Beam Continuity
PC2 ---------------------- Sensor Data
PS0 ---------------------- System Configuration
PS3 ---------------------- Transformation Matrices

RR ----------------------- Recorder Directory
RF ----------------------- Recorder Space used/free (bytes)
RY ----------------------- Upload Recorder Files to Host
```

4.3 Time Set

WinSC sends the ADCP the TS? command. This will show the current setting of the real time clock. For example;

```
>TS?
TS = 98/06/17,07:31:27 --- Time Set (yr/mon/day,hour:min:sec)
>
```

4.4 Recorder Free Space

WinSC sends the ADCP the RS command. This will show the amount of used and free recorder space in megabytes. For example;

```
>RS
RS = 000,010 --------- REC SPACE USED (MB), FREE (MB)
>
```

4.5 Display System Parameters

This tells the ADCP to display specific information about your ADCP. Both *WinSC* and *BBTalk* run this test. For example:

```
>ps0
  Instrument S/N:  0
       Frequency:  307200 HZ
   Configuration:  4 BEAM, JANUS
     Match Layer:  10
      Beam Angle:  20 DEGREES
    Beam Pattern:  CONVEX
     Orientation:  DOWN
       Sensor(s):  HEADING  TILT 1  TILT 2  DEPTH  TEMPERATURE  PRESSURE
Pressure Sens Coefficients:
              c3 = +0.000000E+00
              c2 = +0.000000E+00
              c1 = -2.500000E-03
          Offset = +0.000000E+00

Temp Sens Offset:  -0.20 degrees C

    CPU Firmware:  16.21
   Boot Code Ver:  Required:  1.13   Actual:  1.13
    DEMOD #1 Ver:  ad48, Type:  1f
    DEMOD #2 Ver:  ad48, Type:  1f
    PWRTIMG  Ver:  85d3, Type:   6
Board Serial Number Data:
   08  00 00 02 C9 20 A7  09 CPU727-2000-00H
   4D  00 00 00 D4 97 37  09 PIO727-3000-03C
>
```

Verify the information is consistent with what you know about the setup of your system. If PS0 does *not* list all your sensors, there is a problem with either the communications to the transducer or a problem with the receiver board.

4.6 Instrument Transformation Matrix

PS3 sends information about the transducer beams. Only the *BBTalk* script file TestWH.txt runs this test. The WorkHorse uses this information in its coordinate-transformation calculations; for example, the output may look like this:

```
ps3
Beam Width:   3.7 degrees

Beam     Elevation     Azimuth
  1         -70.14      269.72
  2         -70.10       89.72
  3         -69.99        0.28
  4         -70.01      180.28
```

```
Beam Directional Matrix (Down):
  0.3399    0.0017    0.9405    0.2414
 -0.3405   -0.0017    0.9403    0.2410
 -0.0017   -0.3424    0.9396   -0.2411
  0.0017    0.3420    0.9398   -0.2415

Instrument Transformation Matrix (Down):    Q14:
  1.4691   -1.4705    0.0078   -0.0067       24069  -24092     127    -109
 -0.0068    0.0078   -1.4618    1.4606        -111     127  -23950   23930
  0.2663    0.2657    0.2657    0.2661        4363    4354    4353    4359
  1.0367    1.0350   -1.0359   -1.0374       16985   16957  -16972  -16996
Beam Angle Corrections Are Loaded.
>
```

If the WorkHorse has beam angle errors, they are reflected in the instrument transformation matrix and the Beam Directional matrix. This matrix, when multiplied by the raw beam data gives currents in the *x*, *y*, *z*, and *e* directions.

4.7 Pre-deployment Test

This diagnostic test checks the major WorkHorse modules and signal paths. Both *WinSC* and *BBTalk* run this test. For example, the output may look like this:

```
>PA
PRE-DEPLOYMENT TESTS
CPU TESTS:
  RTC.....................................PASS
  RAM.....................................PASS
  ROM.....................................PASS
RECORDER TESTS:
  PC Card #0..............................DETECTED
    Card Detect...........................PASS
    Communication.........................PASS
    DOS Structure.........................PASS
    Sector Test (short)...................PASS
  PC Card #1..............................DETECTED
    Card Detect...........................PASS
    Communication.........................PASS
    DOS Structure.........................PASS
    Sector Test (short)...................PASS
DSP TESTS:
  Timing RAM..............................PASS
  Demod  RAM..............................PASS
  Demod  REG..............................PASS
  FIFOs...................................PASS
SYSTEM TESTS:
  XILINX Interrupts... IRQ3  IRQ3  IRQ3 ...PASS
  Receive Loop-Back.......................PASS
  Wide Bandwidth..........................PASS
  Narrow Bandwidth........................PASS
  RSSI Filter.............................PASS
  Transmit................................PASS
SENSOR TESTS:
  H/W Operation...........................PASS
```

4.8 Display Heading, Pitch, Roll, and Orientation

The PC2 test displays heading, pitch angle, roll angle, up/down orientation and attitude temperature in a repeating loop at approximately 0.5-sec update rate. Any key pressed exits this command and returns the user to the command prompt. Both *WinSC* and *BBTalk* run this test.

```
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
```

4.9 Beam Continuity

The PC1 tests the beam continuity by measuring the quiescent Receiver Signal Strength Indicator (RSSI) levels. There must be a change of more than 30 counts when the transducer face is rubbed. Both *WinSC* and *BBTalk* run this test.

```
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...
  52  48  50  43

Rub Beam 1 = PASS
Rub Beam 2 = PASS
Rub Beam 3 = PASS
Rub Beam 4 = PASS
```

5 Dock Side Tests

The following checks should occur at Dock Side prior to performing the Sea Acceptance Tests. These tests will verify the WorkHorse ADCP is ready for the Sea Acceptance Tests and confirm the peripherals attached to the ADCP.

NOTE. These tests only apply to moving vessel deployments.

5.1 Dock Side Diagnostic Test

The following test will confirm the connection of the WorkHorse Deck box (Mariner) to the Transducer or WorkHorse to the computer.

Table 1: Dock Side Test Setup

Setup	Description
Platform/Vessel	The vessel should be tied to the dock or at anchor. The transducer should be in water. All other sonar devices and equipment should be turned off.
WorkHorse	Connect the ADCP as described in the appropriate ADCP User's Guide. The Gyro/Navigation connection may or may not be connected at this point.
Computer	The RDI *BBTalk* program should be running, communications port setting (F5) to match the connection to the PC and WorkHorse ADCP baud rate requirements (default 9600,N,8,1).

Use the following steps to interconnect the WorkHorse system and to place the ADCP in a known state.

a. Interconnect and apply power to the system as described in the appropriate ADCP User's Guide.

b. Start the *BBTalk* program.

c. Press **End** to wake up the ADCP. Send the PA command to the ADCP. See "Pre-deployment Test," page 6 for an example of the test result printout.

5.2 Dock Side Peripheral Tests

The WorkHorse requires (at minimum) input for heading (true north) and for position fixes (GPS). Additionally, the WorkHorse can make use of pitch and roll data to correct for the tilt.

Heading can be input directly to the WorkHorse deck box through an external synchro gyro or stepper gyro (Mariner only). Heading can also (or instead of) be input and combined with WorkHorse data in the computer software *VmDas*. This heading input is done through the communications port of the computer with the NMEA 0183 string $HDT or $HDG as specified in the **Transforms** tab in *VmDas*.

If the gyro connection is used for the heading input, then the Gyro Interface Board must be first configured to match the platform's gyro output. Follow the instructions in the Installation Guide on how to setup the Gyro Interface Board.

Pitch and Roll data can be input directly to the Mariner deck box through an external synchro gyro. Pitch and Roll can also (or instead of) be input and combined with WorkHorse data in the computer software *VmDas*. This heading input is done through the communications port of the computer with the RDI proprietary NMEA string $PRDID.

Navigation data can only be combined with WorkHorse data in the computer software *VmDas*. This navigation input is done through the communications port of the computer with the NMEA proprietary strings $GGA and $VTG.

NOTE. See the VmDas User's Guide and/or the WinRiver User's Guide for help on integrating NMEA Devices.

Table 2: Dock Side Peripheral Tests Setup

Setup	Description
Platform/Vessel	The Gyro, Navigation, and Pitch/Roll sensors should be attached to the appropriate place on either the WorkHorse deck box or the computer communication port. The devices should be on and should stable (in the case of gyros this may require a spin up time of up to 12 hours).
WorkHorse	The WorkHorse should be connected as described in the appropriate ADCP User's Guide, AC Power connected to the deck box/ADCP, and the power switch turned on.
Computer	The RDI *BBTalk* program should be running, communications port setting (F5) to match the connection to the PC and WorkHorse ADCP baud rate requirements (default 9600,N,8,1).

Testing the Gyro Connections to the Deck box (Mariner Only)

The following sequence of commands should be sent after powering up the WorkHorse deck box. These commands will wake up the ADCP (<BREAK>), initialize the WorkHorse (CR1), and save the initialization (CK).

```
<BREAK> press the end key
CR1
CK
```

The following command should be sent to test the gyro input to the WorkHorse deck box.

```
PC2
```

The response from the ADCP should be as follows:

```
>PC2
Heading          Pitch       Roll        Temperature
 (ext)           (ext)       (ext)       cts      degs
 000.0           +00.0       +00.0       243E     23.9
```

Testing the Navigation Connections to the Compute (VmDas)r

Start *VmDas* in the Data Collect mode. On the **View** menu, select **Nmea Communications**. Confirm that the Navigation Device NMEA string is viewable and the $GGA string is present.

The **Navigation Data** window in *VmDas* (see Figure 3) shows a text box of the position and velocity data from a NMEA navigation device. You can use this to verify the navigation connections.

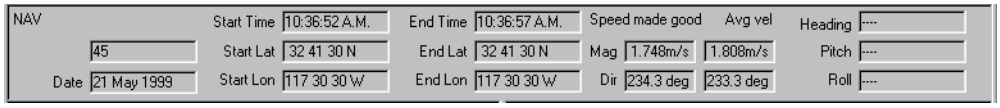

Figure 3. Testing the Navigation Connections

Testing $HDG Heading Connections to the Computer (VmDas)

Start *VmDas* in the Data Collect mode. On the **View** menu, select **Nmea Communications**. Confirm that the Navigation Device NMEA string is viewable and the $HDG string is present. Note that the data for this information may appear on the same communications port as the navigation data or on a separate input port.

Testing $PRDID Heading Connections to the Computer (VmDas)

Start *VmDas* in the Data Collect mode. On the **View** menu, select **Nmea Communications**. Confirm that the Navigation Device NMEA string is viewable and the $PRDID string is present. Note that the data for this information may appear on the same communications port as the navigation data or on a separate input port.

Testing the Navigation Connections to the Compute (WinRiver)r

Start *WinRiver* in the Acquire mode. On the **View** menu, select **Device Logs**. Confirm that the Navigation Device NMEA string is viewable and the $GGA string is present.

Table 3: Dock Side Peripheral Test Results

Test	Test Criterion
External Gyro Connection Test	Verify that the Gyro inputs for Heading, Pitch and Roll (if included) are reasonable for the platform's attitude. The Temperature reading should match the expected water temperature at the transducer.
External Heading NMEA Connection Test	Verify that the Navigation Device NMEA string is viewable and the $GGA string is present.
External Heading NMEA Connection Test	Verify that the Navigation Device NMEA string is viewable and the $HDT or $HDG string is present.
External Heading NMEA Connection Test	Confirm that the Navigation Device NMEA string is viewable and the $PRDID string is present.

6 Sea Acceptance Tests

This procedure is intended to test the WorkHorse at sea. This procedure assumes that the Dock Side Testing (see "Dock Side Tests," page 8) procedure has been run and that all of the items have passed or been confirmed to be operational. The following tests will not obtain favorable results unless all of this work has been performed.

NOTE. These tests only apply to blue water moving vessel deployments using *VmDas*. See the *VmDas* User's Guide for instructions on how to use this program.

Rio Grande ADCPs using *WinRiver* should view the *WinRiver* User's Guide for instructions on integrating GPS and depth sounders. You must perform the ADCP compass correction procedure.

The reason for Sea Acceptance Testing is that although the Dock Side Tests confirm the WorkHorse is operational, they do not confirm that the system is able to perform to its specifications. The performance of any ADCP relies greatly upon the installation into any platform. Therefore, the system must be tested at sea to understand the effects of the platform on the ADCP performance.

At Sea Testing includes tests for Acoustic Interference, Profiling Range, and Profiling Reasonableness testing. For each of these tests the following Equipment and ADCP setup requirements are recommended.

Equipment Required

- WorkHorse 300 kHz, 600 kHz, or 1200 kHz ADCP with firmware 16.xx or greater
- Computer
- *VmDas* Program
- *WinADCP* Program
- Navigation Interface Connected
- Heading Interface Connected

VmDas Setup

a. Start *VmDas*. On the **File** menu, click **Collect Data**. On the **Options** menu, click **Load**. Select the Default.ini file and click **Open**.

b. On the **Options** menu, click **Edit Data Options**. Click the **ADCP Setup** tab. Set the **Ensemble Time** to the **Ping as fast as possible**.

c. Select the **Use Command File** box. Use Table 4 to choose a command file for your ADCP, and load it into *VmDas* using the **Browse** button.

Table 4: Command Files

File Name	Description
WH300DEF.txt	Default setup for a WH 300 kHz ADCP to provide the most range with the optimal precision.
WH600DEF.txt	Default setup for a WH 600 kHz ADCP to provide the most range with the optimal precision.
WH1200DEF.txt	Default setup for a WH 1200 kHz ADCP to provide the most range with the optimal precision.

d. On the **Options** menu, click **Edit Data Options**. Click the **Averaging** tab. Set the **Short Term Average** to 300 seconds (5 minutes). Set the **Long Term Average** to 600 seconds (10 minutes).

6.1 Interference Test

The WorkHorse transmits and receives acoustic signals from the water. If other sonar devices are operating on the platform at the same time as the ADCP it is possible for those signals to bias the ADCP data. Therefore, all ADCPs must be tested to ensure that they are not receiving interference from other sonar equipment on board the vessel.

The following Interference Test will determine if there is interference from other devices on board the vessel.

6.1.1 Interference Test Platform Test Setup

This test requires that the platform be in water deeper than the ADCP's maximum expected profiling range. Use the following table to determine the minimum water depth required.

Table 5: Interference Test Minimum Water Depth Requirement

300 kHz ADCP	600 kHz ADCP	1200 kHz ADCP
400 meters	150 meters	60 meters

The platform speed for this test is drifting. The motors may be running if required for platform safety. The test sequence starts with ALL sonar and non-essential electronic equipment turned off. Only the ADCP should be on for the first test. This test establishes a base line for the interference and is critical to the rest of the tests. After a 10-minute period the first sonar device is turned on, transmission started, and the data is reviewed for interference terms. At the end of this 10-minute period the first sonar device is turned off and than the next sonar device is turned on and started pinging for 10 minutes. This process repeats for each of the sonar devices.

6.1.2 Interference Test Computer Screen Display Setup

View the RAW data (*.ENR files) being collected by the *VmDas* program in the *WinADCP* program contour plots for echo intensity data. This data will show the single ping return levels.

6.1.3 How to Identify Interference

If there is an interference term, the echo intensity data will show spurious echo intensity jobs. An example of what an interference term may look like what is shown in Figure 4, page 14.

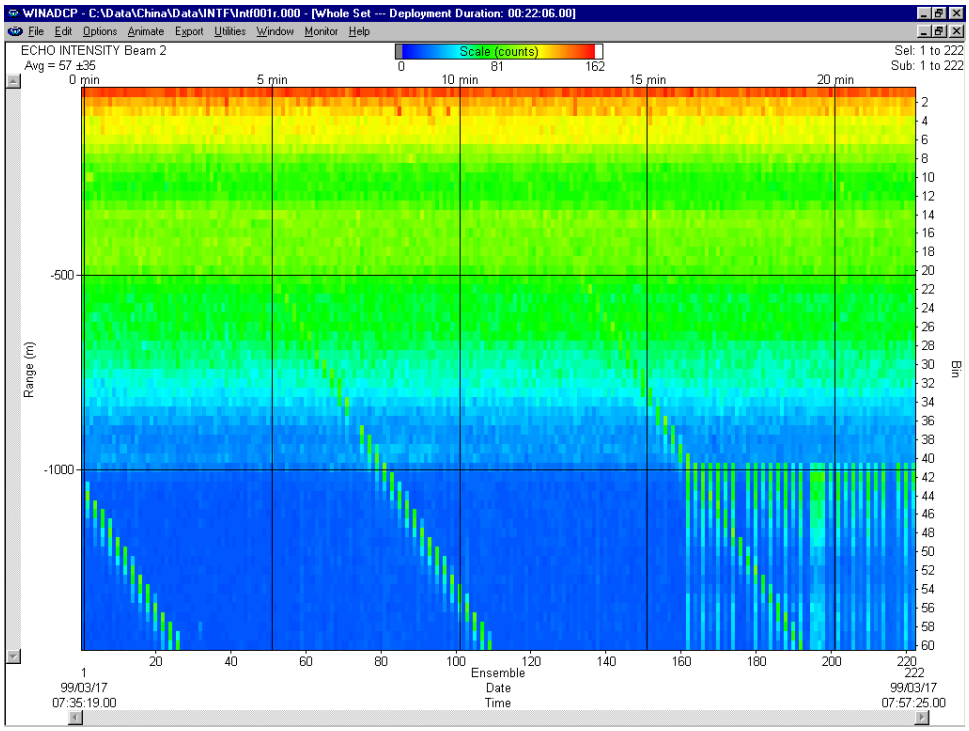

Figure 4. Interference Test

The interference term appears as the periodic green blocks in the data set. The interference is some what lost in the upper part of the profile however it can be seen clearly seen once the system reaches the noise floor (the point where signals are no longer being returned from the water).

NOTE. Interference terms such as above seen anywhere in the echo intensity profile data will result in a bias to the ADCP data.

NOTE. Figure 4 is shown in color in the electronic documentation.

6.2 Water Profile Range Test

The range of any ADCP is directly dependent on the level of backscattering material in the water, the transmit power into the water, the received sensitivity, and the level of the background noise. Each of these effects the range of the system in different ways, but in the end can result in reduced or extended range as follows.

- The ADCPs transmit power and receive sensitivity are fixed based on the transducer frequency. However, these may be affected by installation of an acoustic window in front of the transducer. A window will absorb both sound transmitted by the ADCP and the sound returned from backscatter in the water.
- The volume of the backscatter in the water will affect the range. All specifications for range assume that there is a certain amount of backscatter in the water. The backscatter volume is not controllable in any way.
- The background noise changes as the platform's speed increases or decreases. There are two types of noise created by the moving platform; first, there is the noise due to propeller and engines; and second, there is the noise created by the rushing water across the platform and ADCP transducer.

This test is used to determine the effects of the background noise on the range of the ADCP. This information can be used to determine the optimum speed of the platform to obtain the desired range required.

6.2.1 Water Profile Range Platform Test Setup

This test requires that the platform be in water deeper than the ADCP's maximum expected profiling range. Use the following table to determine the minimum water depth required.

Table 6: Water Profile Range Test Minimum Water Depth

300 kHz	600 kHz	1200 kHz
250 meters	100 meters	40 meters

The platform course for this test is a continuous straight line. The speed of the platform will be varied during this test. At each speed, the system will be set to collect data for a minimum of 10 minutes. The following table lists the recommended speeds.

Table 7: Water Profile Range Test Platform Speed

Test #	Speed
Speed 1	Drifting
Speed 2	3 knots
Speed 3	6 knots
Speed 4	9 knots
Speed 5	12 knots
Speed 6	Maximum Speed

6.2.2 Water Profile Range Computer Screen Display Setup

View the Tabular Display of the Long Term Average data (10 minute averages) in the *VmDas* program.

6.2.3 How to Determine the Maximum Range of the ADCP

The data collected in the long-term average (10 minutes) tabular display will be used to determine the maximum range of the ADCP. The maximum profiling range of the system is determined by locating the last valid bin and then using that ping to determine the range. To determine the last valid bin the following criterion is used:

- The last bin must be above the bottom side lobe area
- The bin must have a percent good value above 25%
- The correlation value for at least 3 beams must be above the threshold of 120 counts

Locate the last valid bin for each of the speeds and fill in the table below.

Platform Speed	Last Valid Bin Number	Range to Last Bin	Average RSSI Value at Last Bin

Notes:

- Platform Speed must be input as a measurement from the Bottom Track (if in range) or the GPS speed.

- Range to Last Bin is calculated as follows: ((bin size) * (last bin number)) + (NF command)
- Average RSSI Value at Last Bin is the average of the 4 beams RSSI values in the last bin number

The results from the above test should be compared to the specified nominal range of the system. Assuming that there are sufficient scatterers in the water, the acoustic window is not attenuating the signal, and that that the platform background noise is variable there should be a speed at which the nominal range of the system is obtained.

6.3 Ringing Test

The ADCP transmits an acoustic pulse into the water. The main lobe of this pulse bounces off particles in the water and the signals returned from these particles are used to calculate the velocity of the water. The main lobe of the transmitted pulse is what we are using to process and calculate a velocity. The transmitted pulse, however, is made up of many side lobes off the main lobe. These side lobes will come in contact with metal of the transducer beam itself and other items in the water.

The energy from the side lobes will excite the metal of the transducer and anything bolted to the transducer. This causes the transducer and anything attached to it to resonate at the system's transmit frequency. We refer to this as "ringing." If the ADCP is in its receive mode while the transducer is ringing then it will receive both the return signals from the water and the "ringing." Both of these signals are then processed by the ADCP. The ringing causes bias to the velocity data.

All ADCPs "ring" for some amount of time. Therefore, each ADCP requires a blanking period (time of no data processing) to keep from processing the ringing energy. Each ADCP frequency has a different typical ringing duration. A blanking period (time of not processing data) is required at the beginning of each profile. The blanking distances required for the typical ringing period for each WorkHorse frequency is shown in the following table.

Table 8: Required Blanking Distance

Frequency	Typical Blank Period for Ringing
300kHz	2 meters
600kHz	1 meters
1200kHz	0.5 meters

Ringing will bias the velocity estimation to a lower value than it should be. However, when the platform motion is removed from the water profile data

it will appear as a large velocity, which is the opposite of what it is really doing. This effect is caused because the vessel motion portion of the water profile data has been biased low.

6.3.1 Ringing Test Platform Test Setup

The key to success on this test is that the water velocity and direction not change over the entire test period of 120 minutes. This may be difficult to adhere to in regions with large tidal effects. The test requires that the platform be within the ADCP bottom tracking range so that valid bottom track can be used. Use the following table to determine the optimum water depth range required.

Table 9: Ringing Test Water Depth Requirement

300kHz ADCP	600kHz ADCP	1200kHz ADCP
100-200 meters	50-100 meters	10-20 meters

Platform speed should be held to as fast a speed as possible without loosing any bottom tracking data for a period of 30 minutes. Typically, this will be a speed of 6-9 knots. Some experimentation may be required to find the maximum bottom track speed for the given depths above.

6.3.2 Ringing Test Computer Screen Display Setup

The Magnitude and Direction Profile Display of the Long Term Average data (10 minute averages) will be viewed in the *VmDas* program.

6.3.3 How to Determine the Ringing Test Results

Viewing the Long Term average of the magnitude and direction profile data, look for unreasonable shears from bin 1 to bin 2 to bin 3 and so on. If an unreasonable shear is seen, this is most likely ringing and your blanking needs to be increased by the following formula:

(bin size) * (last bin number with ringing) * 0.80

*The total blanking period is typical blanking period plus the increased blanking period required. The above value should be used to change both the NF and WF commands in all configuration files for this ADCP.

6.4 Water Profile Reasonableness Test

The mounting alignment of the WorkHorse transducer to the relative position of the heading input from the vessel is critical in the velocity estimates made by the ADCP. If either of these are not known and corrected for, it will result in both directional and velocity estimate errors in the water velocity data.

It is possible to confirm if the transducer alignment is correct by collecting data over the same water in several different directions. If the transducer is properly aligned, then both the magnitude and direction of the currents will appear the same in all directions that the platform travels.

6.4.1 Water Profile Reasonableness Platform Test Setup

The key to success on this test is that the water velocity and direction not change over the entire test period of 120 minutes. This may be difficult to adhere to in regions with large tidal effects. The test requires that the platform be within the ADCP bottom tracking range so that valid bottom track can be used. Use the following table to determine the optimum water depth range required.

Table 10: Water Profile Reasonableness Water Depth Requirement

300 kHz	600 kHz	1200 kHz
100-200 meters	50-90 meters	10-40 meters

Platform speed is held at a constant 5 knots during the entire course. The course for this test contains 4 legs. Each leg must be approximately 4500 meters (except for leg 2 which will be one half the length of each of the other legs). The course will appear as shown in Figure 5. The actual starting direction is not critical as long as the course completes the pattern shown in Figure 5.

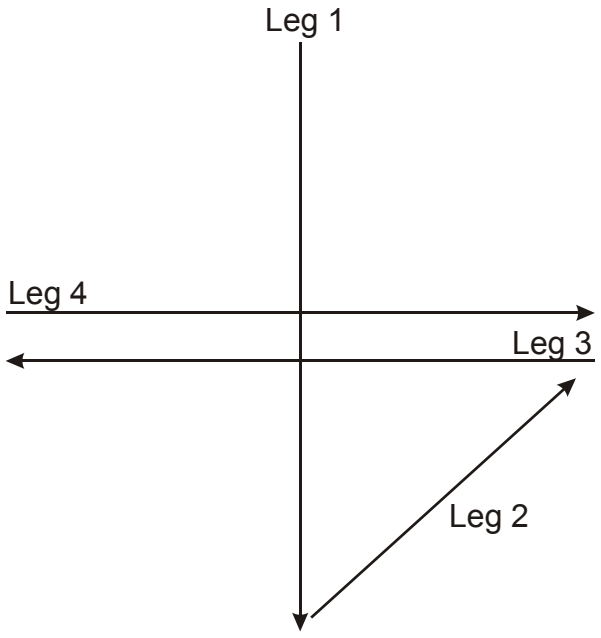

Figure 5. Water Profile Reasonableness Course

6.4.2 Water Profile Reasonableness Display Setup

View the *VmDas* Ship Track display of bin 3 with the bottom track reference. The Short Term Average (5 minute averages) data should be viewed.

6.4.3 How to Determine Water Profile Reasonableness

A pass condition is if the velocities in each of the ship track plotted directions has reasonably the same magnitude and direction. It is common to see some wild velocity magnitude and directions during turns. This happens as a result of the effects of the turn on the gyro heading device or the latency of the heading updates for a GPS heading input.

If the direction of the currents is not the same in each of the four directions, then it will be necessary to enter in a transducer misalignment angle. Changing the transducer alignment angle and playing back the same data file again allows you to determine the misalignment angle. The best way to perform this check out is to use incremental change of 5-10 degrees at a time.

Assuming that the misalignment angle was not required or could be determined, it is now possible to use the same data just collected to determine how reasonable the navigation data input is. Change the data display reference from bottom track to the navigation data in the *VmDas* program. There should be little to no change in the velocity magnitude and direction if the navigation data is a valid input for a reference.

6.5 Bottom Tracking Test

The bottom tracking capability of the ADCP varies depending on the type of bottom (hard, soft, rock, sand, etc.), the slope of the bottom, and the speed of the vessel (background noise).

Before testing the Bottom Track capabilities, the Water Profiling Range Test must be performed. Through the results of this test, determine the platform speed in which the range to the last valid bin obtained the specified nominal range of the ADCP frequency being used.

If it was not possible to reach the specified nominal range during the Water Profiling Range test, then determine the speed at which it allowed the best range possible. Calculate the percentage of the nominal range that was obtained by the system.

6.5.1 Bottom Tracking Platform Test Setup

The key to this test is to operate the system in an area where both the minimum and maximum bottom tracking range can be obtained. The platform will travel over water that is very shallow (<10 meters) to very deep (greater than the maximum bottom track range). It does not matter if the water starts deep and goes shallow or vice-versa.

The course of the platform should be a relatively straight line. The platform speed should be no greater than the velocity recorded in the Water Profiling Range Test.

6.5.2 Bottom Tracking Computer Screen Display Setup

View the raw data display of the *VmDas* bottom track display window.

6.5.3 How to Determine Bottom Tracking Reasonableness

Viewing the bottom track velocity data, record the maximum and minimum average of the bottom track depths in the table below.

Beam Number	Minimum Depth (meters)	Maximum Depth (meters)
Beam 1		
Beam 2		
Beam 3		
Beam 4		

A pass condition is if the maximum depth of the system is equal to the specification for the nominal bottom track range.

NOTE. If the system was not able to water profile to the nominal range, then the bottom track range should be reduced to no more than the same percentage as the water profile loss.

If the Bottom Track **did** obtain the complete range and the Water Profile **did not**, then it is likely that there is insufficient backscatter in the water to obtain the specified range.

NOTES