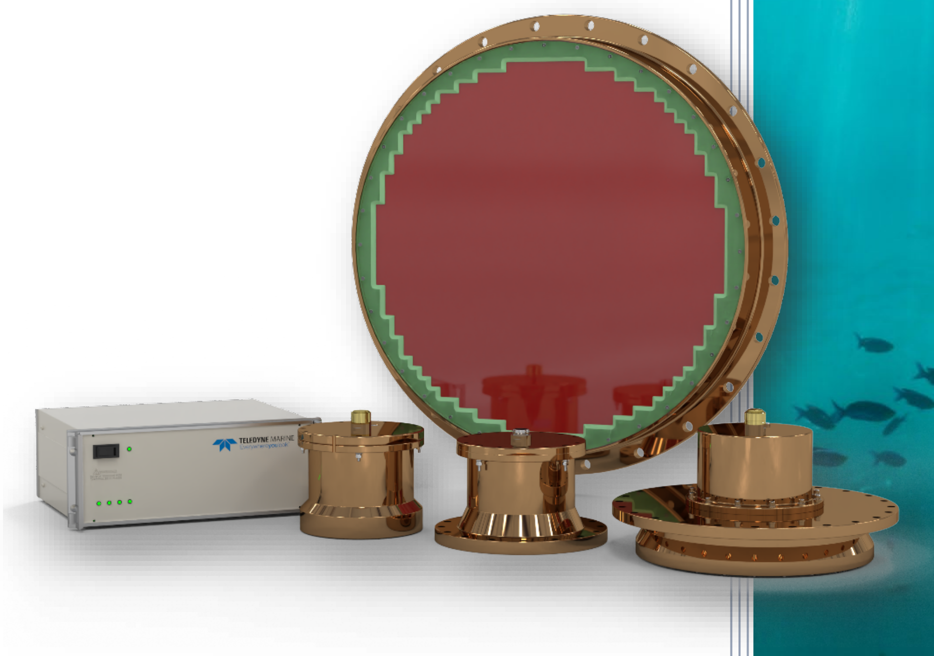
OCEAN SURVEYOR / OCEAN OBSERVER

TECHNICAL MANUAL

TELEDYNE MARINE
Everywhereyoulook™



P/N 95A-6012-00 (January 2024)

https://www.teledynemarine.com/rdi

Table of Contents

Chapter 1 - At a Glance **1**
System Overview 2
Electronic Chassis Overview 3
Transducer Overview 4
I/O Cable Overview 5
Ocean Surveyor/Observer Care 6
General Handling Guidelines 6
Assembly Guidelines 6
Deployment Guidelines 7
Software 7
Software System Requirements 7
Installing the Software 8
Set Up the Ocean Surveyor/Observer 9
Establish Communications 11

Chapter 2 - Maintenance **13**
Maintenance Schedule 14
Parts Location Drawings 15
Electronic Chassis Part Location 15
Transducer Part Location 17
Transducer O-Ring Part Location 20
Spare Parts 23
Inspecting the Transducer and I/O Cable 25
Electronics Chassis Board Replacement 26
Transducer Board Replacement 27
Removing the End-Cap or Top Hat 27
Replacing the Beamformer Board 27
Replacing the TCM2 Compass Board 30
Installing the End-Cap or Top Hat 31
Periodic Maintenance 32
Replacing the Desiccant Bags 32
Replacing the I/O Cable O-Rings 32
Fuse Replacement 33
Prevention of Biofouling 34
Antifouling Paint Recommendations 34
Brass and Bronze Instruments 35
Removal of Biofouling 36
Compass Calibration 37
TCM2 Compass Command Summary 37
TCM2 Field Calibration Procedure 38

Chapter 3 - Testing the Ocean Surveyor/Observer **41**
Dock Side Tests 42
Dock Side Diagnostic Tests 42
Display System Parameters 43
Interference Verification Test 44
Bandwidth Verification Test 45
Dock Side Peripheral Tests 45
Sea Acceptance Tests 46
Interference Test 47
Interference Test Platform Test Setup 47
Interference Test Computer Screen Display Setup 48
How to Identify Interference 48
Water Profile Range Test 49

Water Profile Range Platform Test Setup 49
Water Profile Range Computer Screen Display Setup 50
How to Determine the Maximum Range of the ADCP 50
Ringing Test 50
Ringing Test Platform Test Setup 51
Ringing Test Computer Screen Display Setup 51
How to Determine the Ringing Test Results 51
Transducer Alignment Test 52
Platform Testing Setup 52
Computer Screen Display Setup 53
Transducer Alignment Results Sheet 53
Bottom Tracking Test 54
Bottom Tracking Platform Test Setup 54
Bottom Tracking Computer Screen Display Setup 54
How to Determine Bottom Tracking Reasonableness 54

CHAPTER 4 – TROUBLESHOOTING 55
Equipment Required 57
Basic Steps in Troubleshooting 57
Troubleshooting Safety 58
Troubleshooting a Communication Failure 59
Communication Failure Quick Checks 59
Checking the Serial Communications Channels 59
RS-422 Communication 60
Communication Mismatch 60
Checking the Serial Cable 60
Electronics Chassis Checks 61
Checking the Power Supply 62
Troubleshooting a Built-In Test Failure 63
Failure Scenario: PT3 Test Fails 63
Failure Scenario: PT6 Test Fails 65
Troubleshooting a Beam Failure 66
Troubleshooting Data Problems 67
Troubleshooting a Sensor Failure 71
Troubleshooting the TCM2 Compass 72
Troubleshooting Software Problems 74
Ocean Surveyor Cables 75
Checking the Transducer I/O Cable 75
Transducer Wet Connector Wiring Resistance Check 78
Transducer Dry Connector Resistance Check 79
Serial Data Communications Cables 81
System Overview 82
Overview of Normal Ocean Surveyor Operation 82
Functional Description of Operation 84
Input Power 84
Board Descriptions 85

CHAPTER 5 - RETURNING ADCPS TO TRDI FOR SERVICE 91
Shipping the ADCP 92
Returning Systems to the TRDI Factory 93
Returning Systems to TRDI Europe Factory 94

CHAPTER 6 – COMMANDS 97
Data Communication & Command Format 98
Command Input Processing 98
Data Output Processing 99
Command Descriptions 102
Miscellaneous Commands 102
? - Help Menus 102

Break 102
Soft Break 103
V - Display Banner 103
Bottom-Track Commands 104
Available Bottom-Track Commands 104
Bottom-Track Command Descriptions 104
BA - Amplitude Threshold 104
BC - Correlation Threshold 104
BE - Error Velocity Threshold 105
BP - Bottom-Track Pings 105
BX - Maximum Tracking Depth 106
Control System Commands 107
Available Control System Commands 107
Control System Command Descriptions 107
CB - Serial Port Control 107
CC – Suppress Pair 108
CF - Flow Control 109
CK - Keep Parameters 110
CM – Suppress Beam 110
CR - Retrieve Parameters 111
CS - Start Pinging (Go) 111
CU – Use Calibrated RSSI 111
CW – Select Dual Mode Data 112
CX – Trigger Input/Output 112
Environmental Commands 114
Available Environmental Commands 114
Environmental Command Descriptions 114
EA - Heading Alignment 114
EC - Speed of Sound 115
ED - Depth of Transducer 116
EE - Attitude Data Output and Interpolation 116
EF - External Pitch/Roll Factor 117
EH - Heading Angle 118
EI - Roll Misalignment Angle 118
EJ - Pitch Misalignment Angle 119
EP - Pitch and Roll Angles 119
ER - Roll (Tilt 2) 120
ES - Salinity 120
ET - Temperature 120
EU - Up/Down Orientation 121
EV - Heading Bias 121
EX - Coordinate Transformation 122
EZ - Sensor Source 124
Fault Log Commands 126
Available Fault Log Commands 126
Fault Log Command Descriptions 126
LC - Clear Fault Log 126
LD - Display Fault Log 126
LL - Display Fault List 127
Narrow Bandwidth Profiling Commands 128
Available Narrow Bandwidth Profiling Commands 128
Narrow Bandwidth Profiling Command Descriptions 128
NA – Narrow Bandwidth Profiling False Target Threshold 128
ND - Narrow Bandwidth Profiling Data Out 128
NE - Narrow Bandwidth Profiling Error Velocity Threshold 129
NF - Narrow Bandwidth Profiling Blank after Transmit 129
NN - Narrow Bandwidth Profiling Number of Profile Depth Cells 130

NP - Narrow Bandwidth Profiling Pings Per Ensemble 130
NS - Narrow Bandwidth Profiling Depth Cell Size 130
Performance and Testing Commands 131
Available Performance and Testing Commands 131
Performance and Testing Command Descriptions 131
PA - Built-In Tests 131
PC - Show Sensor Data 131
PD - Data Stream Select 132
PS - Display System Parameters 132
PS0 132
PS1 132
PS2 133
PS4 133
PT - Diagnostic Tests 133
PT0 - Help 133
PT3 - Receive Path Test 134
PT5 – Electronics Wrap Test 134
PT6 - Receive Bandwidth Test 135
Timing Commands 136
Available Timing Commands 136
Timing Command Descriptions 136
TC - System Timer Value 136
TE - Time Per Ensemble 136
TP - Time Between Pings 137
TS - Set System Date and Time 137
Broad Bandwidth Water-Profiling Commands 138
Available Broad Bandwidth Water-Profiling Commands 138
Broad Bandwidth Water-Profiling Command Descriptions 138
WA – Broad Bandwidth Profiling False Target Threshold 138
WC - Broad Bandwidth Profiling Water Correlation Threshold 139
WD - Broad Bandwidth Profiling Data Out 139
WE - Broad Bandwidth Profiling Error Velocity Threshold 140
WF - Broad Bandwidth Profiling Blank after Transmit 140
WN - Broad Bandwidth Profiling Number of Depth Cells 140
WP - Broad Bandwidth Profiling Pings per Ensemble 141
WS - Broad Bandwidth Profiling Depth Cell Size 141
WV - Broad Bandwidth Profiling Ambiguity Velocity 141

CHAPTER 7 - OUTPUT DATA FORMAT 143
Binary Output and VmDas 144
Binary Standard Output Data Buffer Format 144
PDDecoder Library in C language 146
Binary Header Data Format 147
Binary Fixed Leader Data Format 149
Binary Variable Leader Data Format 154
Binary Velocity Data Format 159
Binary Correlation Magnitude, Echo Intensity, Percent Good, and Status Format 161
Binary Bottom-Track Data Format 165
Binary Fixed Attitude Data Format 168
Binary Variable Attitude Data Format 170
Binary Navigation Data Format 175
Binary Reserved BIT Use 181
Binary Checksum Data Format 181

APPENDIX A - NOTICE OF COMPLIANCE 183
Date of Manufacture 184
Environmental Friendly Use Period (EFUP) 184
WEEE 184

Material Disclosure Table....185
Other Directives....186

List of Figures

Figure 1. Electronic Chassis Overview (Front View)....3
Figure 2. Electronic Chassis Overview (Rear View)....3
Figure 3. Transducer Overview (38 kHz Round Transducer Shown)....4
Figure 4. I/O Cable....5
Figure 5. Ocean Surveyor/Observer RS-232 Serial Connections....10
Figure 6. Ocean Surveyor/Observer RS-422 Serial Connections....10
Figure 7. Electronic Chassis (Top View) with Cover Removed....15
Figure 8. Electronic Chassis (Right View - Looking Toward the Power Assembly PCB)....16
Figure 9. Transducer PCB Layout (38 kHz Round Transducer Shown)....17
Figure 10. Transducer PCB Layout (150 kHz Transducer Shown)....18
Figure 11. Transducer PCB Layout (75 kHz Transducer Shown)....19
Figure 12. Ocean Surveyor/Observer 38kHz O-ring Locations (Early Phase 2 Builds)....20
Figure 13. Ocean Surveyor/Observer 38kHz O-ring Locations (Standard Phase 2 Builds)....21
Figure 14. Ocean Surveyor/Observer 75kHz O-ring Locations....22
Figure 15. Ocean Surveyor/Observer 150kHz O-ring Locations....23
Figure 16. Beamformer Cable Connections....29
Figure 17. Beamformer Cable....29
Figure 18. Old versus New Beamformer Cable Connections....30
Figure 19. Testing the Navigation Connections....46
Figure 20. Interference Test....48
Figure 21. Transducer Alignment Test....52
Figure 22. Transducer Alignment Display....53
Figure 23. Repeating Pattern of Interference Terms in the Echo Intensity Contour Plot....68
Figure 24. Repeating Pattern of Interference Terms in the Horizontal Magnitude....68
Figure 25. Expected Output Levels for Ocean Observer in NB Mode....69
Figure 26. Weak Returns on a Single Beam (Beam 2) for Ocean Observer in BB Mode....69
Figure 27. Weak Returns on all Four Beams for Ocean Observer in BB Mode....70
Figure 28. Range Limited at the Noise Floor for Ocean Surveyor in BB Mode....70
Figure 29. External I/O Cable Wiring (Drawing Number 73A-6010)....77
Figure 30. End-Cap Pin-Out and Internal I/O Cable Wiring....79
Figure 31. Serial Communication Cable Wiring Diagram....81
Figure 32. RS-422 to RS-232 Converter Wiring (Part Number 73A-6015-00)....82
Figure 33. Ocean Surveyor Block Diagram....83
Figure 34. Ocean Observer Block Diagram....84
Figure 35. Power Assembly Board....85
Figure 36. Motherboard....86
Figure 37. Transducer Interface Board....87
Figure 38. Data I/O Interface Board....87
Figure 39. TCM2 Board....88
Figure 40. Beam Former Board....89
Figure 41. Y-axis Alignment....115
Figure 42. ADCP Coordinate Transformation....123
Figure 43. Heading Sensor Source and the Application of EV and EA....125
Figure 44. Binary Standard Output Data Buffer Format (WP or NP Command)....144
Figure 45. Binary Standard Output Data Buffer Format (WP and NP Command)....145
Figure 46. Binary Header Data Format....147
Figure 47. Binary Fixed Leader Data Format....150
Figure 48. Binary Variable Leader Data Format....155
Figure 49. Binary Velocity Data Format....159
Figure 50. Binary Correlation Magnitude, Echo Intensity, Percent Good and Status Format....161

Figure 51. Binary Bottom-Track Data Format 166
Figure 52. Binary Fixed Attitude Data Format 169
Figure 53. Binary Variable Attitude Data Format 171
Figure 54. Binary Navigation Data Format 177
Figure 55. Binary Reserved BIT Use 181
Figure 56. Binary Checksum Data Format 181

LIST OF TABLES

Table 1. Ocean Surveyor/Ocean Observer Electronics Chassis Power 2
Table 2. Ocean Surveyor/Ocean Observer Transducer Power Requirements 2
Table 3: Ocean Surveyor/Observer Software Main Modules 7
Table 4: Spare Parts 23
Table 5. O-Ring Replacement Part Numbers 24
Table 6: Recommended Maximum Thickness of Cuprous Oxide 669 Paint 35
Table 7: TCM2 Dumb Terminal Commands 37
Table 8: Dock Side Test Setup 42
Table 9: Dock Side Peripheral Tests Setup 45
Table 10: Dock Side Peripheral Test Results 46
Table 11: Ensemble Time 47
Table 12: Command Files 47
Table 13: Interference Test Minimum Water Depth Requirement 48
Table 14: Water Profile Range Test Minimum Water Depth 49
Table 15: Water Profile Range Test Platform Speed 49
Table 16: Required Blanking Distance 51
Table 17: Ringing Test Water Depth Requirement 51
Table 18: Transducer Alignment Test Water Depth Requirement 52
Table 19: List of Least Replaceable Assemblies 56
Table 20: Required Test Equipment 57
Table 21: Electronic Chassis Voltage Checks 62
Table 22: I/O Cable End to End Cable Resistance Check 75
Table 23: Transducer Wet Connector Wiring Resistance Check 78
Table 24: Transducer Dry Connector Resistance Check 80
Table 25: Ocean Surveyor Input Power Requirements. 84
Table 26: ADCP Input Command Summary 99
Table 27: ADCP Factory Defaults 101
Table 28: Serial Port Control 107
Table 29: Baud Rate 108
Table 30: Beam Suppression 109
Table 31: Flow Control 109
Table 32: CX Command Description 113
Table 33: Coordinate Frame 116
Table 34: Coordinate Transformation Processing Flags 122
Table 35: Sensor Source Switch Settings 124
Table 36: Standard or Standard Plus 1 Data Format IDs 146
Table 37: Binary Header Data Format 148
Table 38: Binary Fixed Leader Data Format 151
Table 39: Binary Variable Leader Data Format 156
Table 40: Binary Velocity Data Format 160
Table 41: Binary Correlation Magnitude Data Format 162
Table 42: Binary Echo Intensity Data Format 162
Table 43: Binary Percent-Good Data Format 164
Table 44: Binary Status Data Format 164
Table 45: Binary Bottom-Track Data Format 167
Table 46: Binary Fixed Attitude Data Format 169

Table 47: Variable Attitude Identification Word 172
Table 48: Binary Variable Attitude Data Format 173
Table 49: Binary Navigation Data Format 178
Table 50: Binary Reserved for TRDI Format 181
Table 51: Binary Checksum Data Format 181
Table 52: Toxic or Hazardous Substances and Elements Contained in Product 185

Manual Revision History

January 2024

- Updated Figure 29. External I/O Cable Wiring (Drawing Number 73A-6010).
- Updated Returning Systems to the TRDI Factory, page 93 Brokerage address.
- Updated PT5 test results, page 134.

July 2023

- Updated website address.

January 2023

- Updated the EAR statement.
- Deployment guide is now download only.

April 2022

- Removed the zinc anode inspection and replacement section.
- Updated Installing the Software section.

October 2021

- Removed Gyrocompass Interface – no longer sold

September 2021

- Corrected Vent Plug O-Ring P/N 97Z-6084-01 size from 3-094 to 3-904.

July 2021

- Added using *TRDI Toolz*.
- Added Table 6, page 24 O-Ring replacement part numbers.
- Added the PDDecoder link to page 146. Use the Teledyne Marine library to decode Teledyne RD Instruments (TRDI) PD0 data types.

December 2020

- Added information on the water-blocked cable to the I/O Cable Overview section.
- Corrected Figure 4 and non-water blocked cable OD.
- Updated Table 21, End-to-End Resistance.
- Updated Table 22 and Table 23 Note 6b VXDC to VXDC GND, forward bias value from ~ 1.5 VDC to ~ 1.9 VDC.
- Add temperature sensor test PC2 command during dock test prior to checking peripheral inputs such as heading, GPS, etc.

- Added end-cap face and bore O-Ring size to Figure 15 Ocean Surveyor/Observer 150kHz O-ring Locations.

August 2018

- Updated Appendix A - Notice of Compliance with Other Directives.

April 2018

- New Deployment Guide and Getting Started replaces the Setup card and Quick Reference Card.
- Corrected system overview power specifications on page 3.
- Added RS-232/RS-422 Converter information to “Set Up the Ocean Surveyor/Observer section”.
- Added information on Vent Plug to Transducer Overview.
- Added a maintenance schedule.
- Updated Parts Location drawings.
- Updated outline Installation drawings (see Installation Guide).
- Added Export Administration Regulations (EAR) footers.

April 2014

- Added corrections for ICN151.

March 2013

- Updated Beamformer PCB replacement section.
- Added shock warning for array.

December 2012

- Updated description for BX command.
- Added Binary Status Data Format table.
- Corrected the Notice of Compliance.

August 2012

- Updated styles and fonts.
- Updated maintenance procedures for antifouling paint.
- Added corrections from ICN073 (Deployment Guideline Changes).
- Added corrections from ICN093 (Notice of Compliance).
- Added corrections from ICN125 (Transducer I/O Cable Wiring Resistance Check).
- Added corrections from ICN137 (TCM2 Dumb Terminal Command).
- Added FST-028 Beamformer Board Replacement to Maintenance section.
- Added correction to I/O cable diameter.

February 2007

- Reorganized manual – no longer uses separate guides except for the Installation Guide 95A-6019-00
- Obsolete – Ocean Surveyor/Observer User's Guide 95A-6013-00 – no longer needed.
- Updated logos, contact info and company name
- Added corrections from the following ICNs: ICN028, ICN031, ICN035, ICN046
- Updated commands and Output Data Format to match firmware version 23.15

Exclusions and Omissions

1. See Installation Guide for outline installation drawings and specifications.

How to Contact Teledyne RD Instruments

If you have technical issues or questions involving a specific application or deployment with your instrument, contact our Field Service group:

Teledyne RD Instruments	Teledyne RD Instruments Europe
14020 Stowe Drive Poway, California 92064	2A Les Nertieres 5 Avenue Hector Pintus 06610 La Gaude, France
Phone +1 (858) 842-2600	Phone +33(0) 492-110-930
Sales – rdisales@teledyne.com	Sales – rdie@teledyne.com
Field Service – rdifs@teledyne.com	Field Service – rdiefs@teledyne.com

Client Services Administration – rdicsadmin@teledyne.com

Web: https://www.teledynemarine.com

For all your customer service needs including our emergency 24/7 technical support, call +1 (858) 842-2700

Self-Service Customer Portal

Use our online customer portal at https://www.teledynemarine.com/support/RDI/technical-manuals to download manuals or other Teledyne RDI documentation.

Teledyne Marine Software Portal

Teledyne RD Instruments Firmware, software, and Field Service Bulletins can be accessed only via our Teledyne Marine software portal.

To register, please go to https://tm-portal.force.com/TMsoftwareportal to set up your customer support account. After your account is approved, you will receive an e-mail with a link to set up your log in credentials to access the portal (this can take up to 24 hours).

Once you have secured an account, use the Teledyne Marine software portal to access this data with your unique username and password.

If you have an urgent need, please call our Technical Support hotline at +1-858-842-2700.

CONVENTIONS USED IN MANUALS

Conventions used in the Ocean Surveyor/Observer manuals have been established to help you learn how to use the Ocean Surveyor/Observer 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.

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

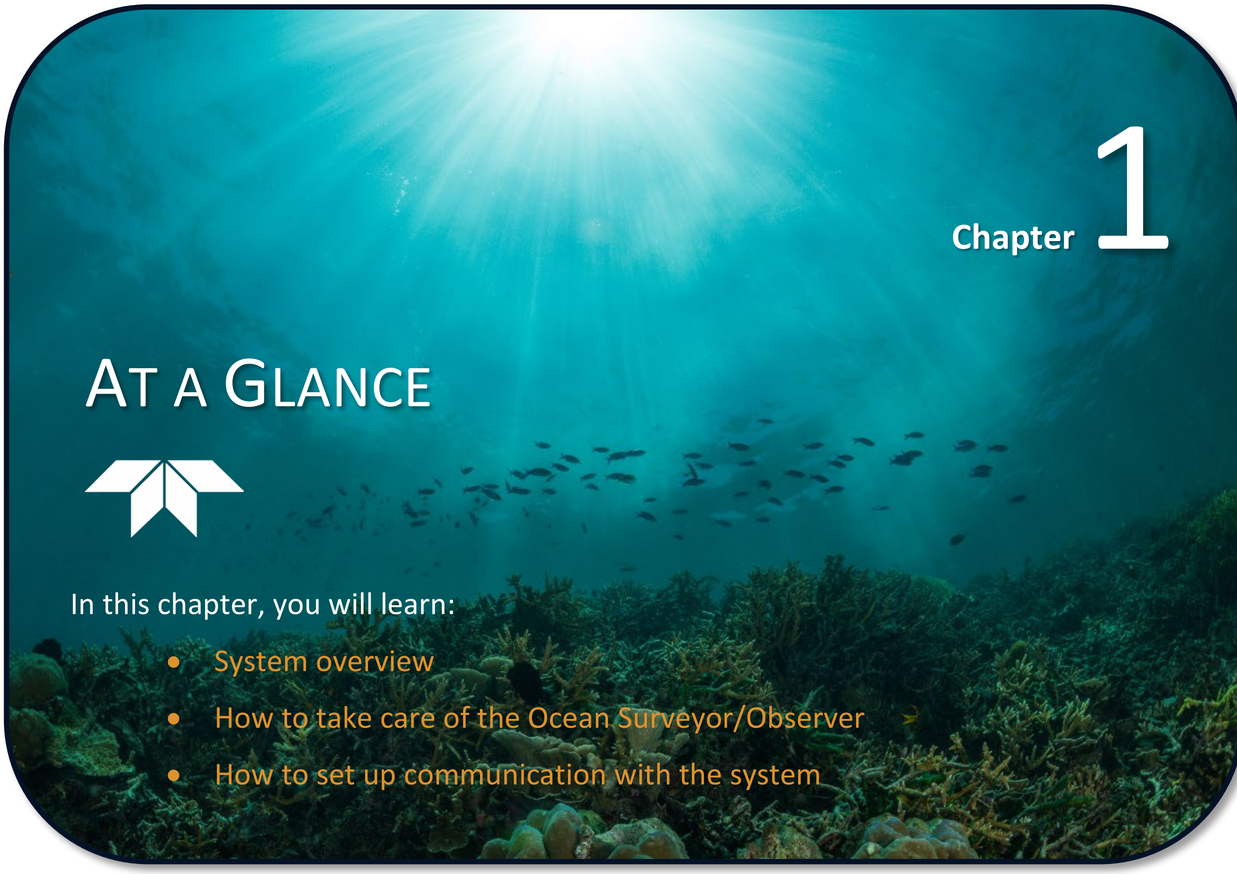
```
Ocean Surveyor Broadband/Narrowband ADCP
RD INSTRUMENTS (c) 1997-2000
ALL RIGHTS RESERVED
Firmware Version 23.xx

>
```

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

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

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



Chapter 1

AT A GLANCE

In this chapter, you will learn:

- System overview
- How to take care of the Ocean Surveyor/Observer
- How to set up communication with the system

System Overview

The Ocean Surveyor/Ocean Observer is designed for vessel-mount or fixed-mount current profile measurement in the upper ocean water from depths less than 100 meters. The system consists of a transducer and electronics chassis. The transducer housing is made from naval bronze and can be painted (with precautions) with anti-fouling paint. Data are transmitted in either an ASCII or binary format through the I/O cable.

Table 1. Ocean Surveyor/Ocean Observer Electronics Chassis Power

Electronics Chassis Input Voltage	90-120VAC or 220-240VAC, 47-63Hz
Electronics Chassis Output Voltage	48VDC 50Amps Max
Input Power (between transmit)	60W Typical
Input Current @ 230VAC	<34Amps rms
Ride through time	20ms
Transient Surge	EN/IEC 1000-4-2 Level 4
Common mode & normal mode	EN/IEC 1000-4-5 Level 3

Recommended UPS 3200Watts (2200Watts Minimum)

Table 2. Ocean Surveyor/Ocean Observer Transducer Power Requirements

ADCP Input Voltage	24-48VDC (48VDC Typical)
Power	1600W peak
Inrush Current	<46A
Transmit Power	1100W typical
Standby Power	2W

Electronic Chassis Overview

The Electronic Chassis (see Figure 1 and Figure 2) contains all of the interfaces to and from the transducer, computer, and power.

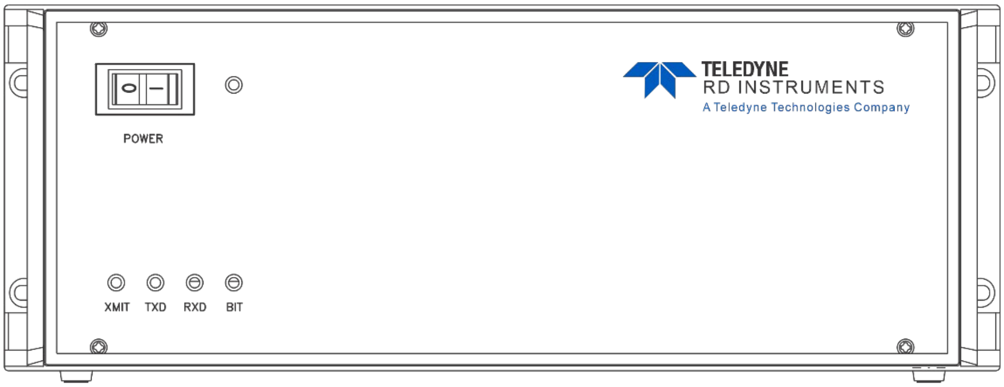


Figure 1. Electronic Chassis Overview (Front View)

Power Switch – The power switch is a combination switch/circuit breaker. The power status LED next to the circuit breaker lights when power is applied to the electronic chassis.

LEDs

- XMIT indicates the transducer is transmitting.
- TXD indicates data transmission from the Ocean Surveyor to the computer.
- RXD indicates data transmission from the computer to the Ocean Surveyor.
- BIT indicates a Built-In Test failure.

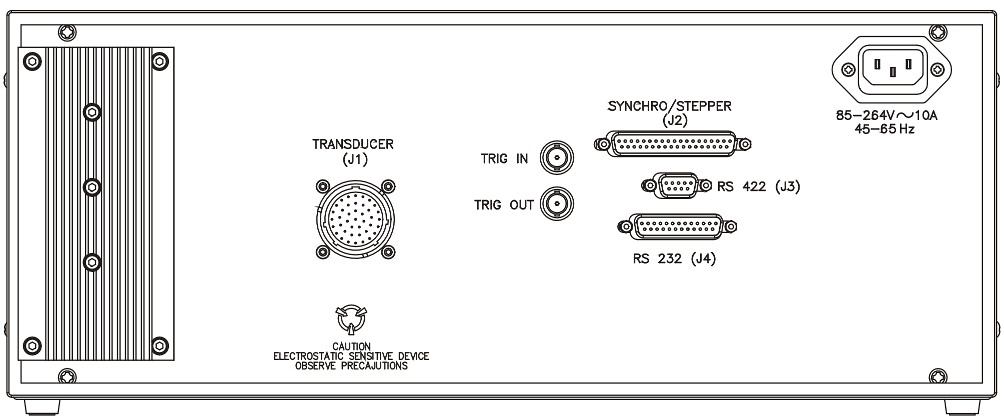


Figure 2. Electronic Chassis Overview (Rear View)

Transducer (J1) Connector – Input/Output (I/O) cable connects the Ocean Surveyor transducer to the Electronic Chassis.

Trigger Input/Output Connectors – The Trigger Input allows the Ocean Surveyor II to be pinged by an external +5Vlogic level signal. The minimum duration for the Trigger Input is 1ms. The Input resistance is at least 2.7 k Ohm. The Trigger Output is a +5V logic level signal as well. The nominal source resistance of the Trigger Output is 50 Ohms.

The command that controls the Trigger Output and Input is *CXab*, where *a* controls the Trigger Input mode, and *b* the Trigger Output mode. For flexibility, several modes for the Trigger Input and Output operation have been implemented. For more information, see the CX-command.

Communications (J3 and J4) Connectors – Allows electronic chassis-to-ADCP communications in either RS-232 on the J4 connector (< 15 meter length I/O cable) or RS-422 on the J3 connector (> 15 meter length I/O cable).

Power In – The electronics chassis automatically scales the input voltage to the proper level. No special jumpers or switch settings are required to select the input voltage. The electronics chassis accepts input voltages of 90 to 250 VAC, 47 to 63 Hz. This input voltage is converted to 48 VDC by the chassis power supply. This is the voltage supplied to the power assembly board. For details on power requirements, see the Installation Guide.

Transducer Overview

The transducer assembly contains the transducer ceramics and electronics. Standard acoustic frequencies are 38, 75, and 150 kHz. See the outline drawings in the Installation Guide for dimensions and weights.

I/O Cable Connector – Input/Output (I/O) cable connects the Ocean Surveyor transducer to the Electronic Chassis.

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

Vent Plug – The vent plug is used by TRDI for a helium leak test and nitrogen purge during manufacturing or repair.

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

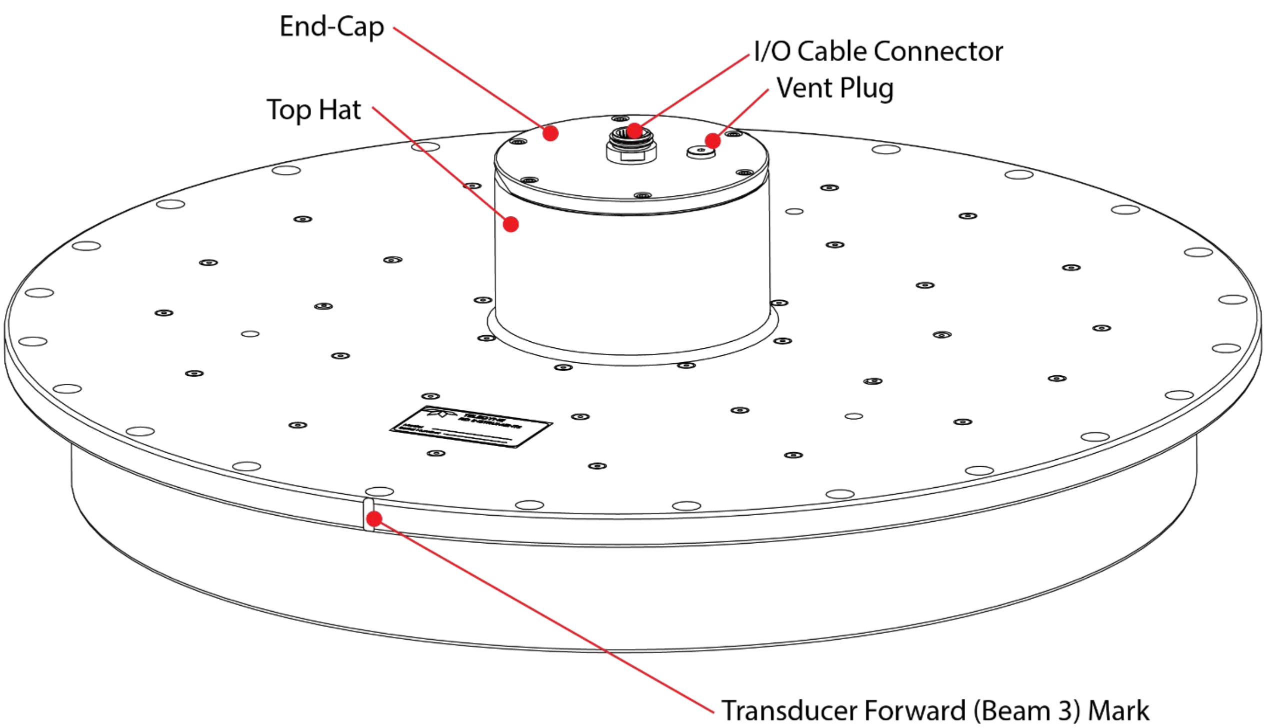


Figure 3. Transducer Overview (38 kHz Round Transducer Shown)

> ⚠ The I/O connector on the transducer uses a 2-020 O-ring and the I/O cable (wet end) uses a 2-022 O-ring. **Always check that both O-rings are in place when connecting the I/O cable to the transducer.** The 2-022 O-ring has a tendency to fall out if the cable connector is dropped. If either of these O-rings are missing or damaged, the transducer will flood.

I/O Cable Overview

The I/O cable connects the Ocean Surveyor transducer to the Electronics Chassis.

73A-6010-xxx Cable specifications non-blocked (default cable for Ocean Surveyors):

- Minimum bend radius = 203 mm (8.0 in.)
- Typical cable OD = 19.812 mm ± 3.048 mm (0.780 ± 0.12 in.)
- Maximum pull load = 3432.3 N (771.6 lb.)
- Breaking Strength = 4448.3 N (1000 lb.)
- Maximum length = 100 m (328 ft.)
- Available with either ends having straight or angled connectors or a combination thereof (see Figure 4).

73A-6038-xxx Cable specifications water blocked (default cable for Ocean Observers/Rigs):

- Minimum bend radius = 203 mm (8.0 in.)
- Typical cable OD = 21.59 mm ± 3.048 mm (0.850 in. ± 0.12 in.)
- Maximum pull load = 3432.3 N (771.6 lb.)
- Breaking Strength = 4448.3 N (1000 lb.)
- Maximum length = 100 m (328 ft.)
- Available with either ends having straight or angled connectors or a combination thereof (see Figure 4).

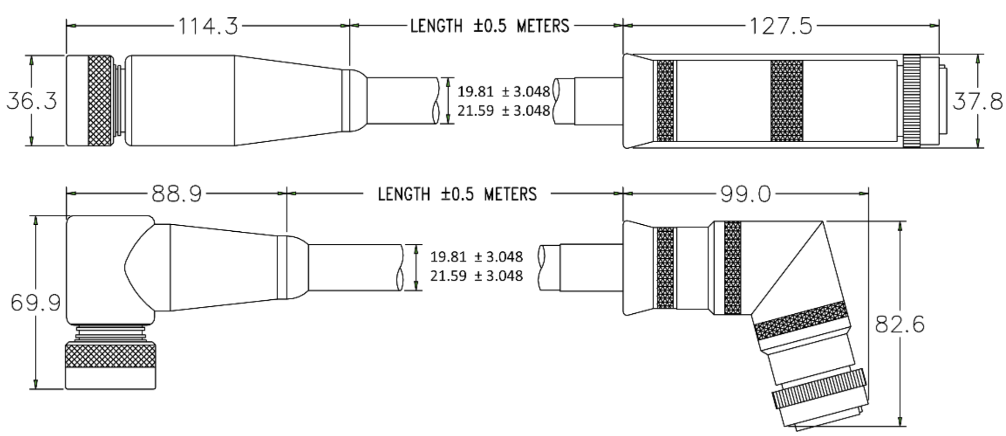


Figure 4. I/O Cable

> ⚠ The I/O connector on the transducer uses a 2-020 O-ring and the I/O cable (wet end) uses a 2-022 O-ring. **Always check that both O-rings are in place when connecting the I/O cable to the transducer.** The 2-022 O-ring has a tendency to fall out if the cable connector is dropped. If either of these O-rings are missing or damaged, the transducer will flood.

Ocean Surveyor/Observer Care

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

General Handling Guidelines

Do NOT ping the Ocean Surveyor/Observer with the transducer in air. The power assembly board will short, causing the electronics chassis to no longer communicate. The transducer is pinged by sending a CS or PT5 command or if *VmDas* is started for collecting data – either of these methods will cause damage if the transducer is in air.

- Never set the transducer on a hard or rough surface. The urethane face may be damaged.
- Do not expose the transducer to prolonged sunlight. The urethane face may develop cracks. Cover the transducer face on the Ocean Surveyor if it will be exposed to sunlight.
- Do not scratch or damage the O-ring surfaces or grooves. All O-ring grooves and surfaces must be inspected for scratches or damages on every re-assembly. Do not risk a deployment with damaged O-ring surfaces.
- Do not lift or support an Ocean Surveyor by the external I/O cable. The connector or cable will break.
- Use three 0.5-inch eyelet bolts to lift a 38 kHz transducer. See outline installation drawing 96A-6009 for the bolt hole locations.

Assembly Guidelines

- Make sure the top hat assembly O-rings stay in their groove when you re-assemble the Ocean Surveyor/Observer. Tighten the Top Hat hardware as specified. Loose, missing, or stripped Top Hat mounting hardware or damaged O-rings can cause the Ocean Surveyor/Observer transducer to flood.

Shock Hazard!

Always treat the array as if it is charged. The array may hold a residual charge created by even minor temperature or pressure changes.

Do not come in contact with any traces on the beamformer board while the P1, P2, P3, and P4 row and column cables are connected.

- The I/O connector on the transducer uses a 2-020 O-ring. **Make sure this O-ring is in place before connecting the cable.**
- The I/O cable (wet end) uses a 2-022 O-ring. **Always check that the I/O cable O-ring is in place when connecting the I/O cable to the transducer.**

The 2-022 O-ring has a tendency to fall out if the cable connector is dropped. If either of these O-rings are missing or damaged, the Ocean Surveyor/Observer transducer will flood.

Deployment Guidelines

- Use the default Command Files (installed to the same directory as *VmDas*) to help setup the Ocean Surveyor/Observer.

> The Ocean Surveyor/Observer transducer may be damaged by pressure waves from seismic activity. Do not deploy the ADCP where it is subject to significant pressure waves from the operation of seismic air guns or similar equipment.

Software

TRDI has utility programs to help you set up, use, test, and troubleshoot your Ocean Surveyor/Observer ADCP. Each program has a pdf format User's Guide on the CD, or you can view the pdf help file while running the program.

Table 3: Ocean Surveyor/Observer Software Main Modules

Program Name	Description
VmDas	VmDas is a software package for data collection, reprocessing, and replay. For detailed information on how to use *VmDas*, see the VmDas User's Guide included on the Marine Measurements CD.
TRDI Toolz	Windows ADCP communication program. Use this program to "talk" to the ADCP and to run test script files. *TRDI Toolz* is included on the Marine Measurements CD.
WinADCP	Gives users a visual display of the entire set of data. You can zoom in on a portion of the data for closer analysis and export data to text or MatLab files. For detailed information on how to use *WinADCP*, see the WinADCP User's Guide included on the Marine Measurements CD.
Marine Measurements CD	The Marine Measurements CD has an Adobe Acrobat® (*.pdf) electronic version of the Ocean Surveyor Technical Manual. Use the Documentation CD to search for information.

Software System Requirements

The Ocean Surveyor/Observer software requires the following:

- Windows® 10, 8.1, 7, or XP
- Pentium III 600 MHz class PC (higher recommended)
- 1GB of RAM (2GB or more RAM recommended)
- 50 MB Free Disk Space plus space for data files (A large, fast hard disk is recommended)
- Minimum of one serial port; number of ports is dependent on the application. *VmDas* can use up to six serial ports in some configurations (High Speed Serial Ports recommended).
- Minimum display resolution of 1024 x 600, 768 color
- CD-ROM Drive
- Mouse or other pointing device
- An Ethernet card if network I/O is desired

Installing the Software

The Ocean Surveyor/Observer documentation and software are downloaded.

1. Follow the instruction sheet on downloading TRDI software and manuals.
2. Software is available on https://tm-portal.force.com/TMsoftwareportal. Install *TRDI Toolz, WinADCP* and *VmDas*.
3. Use our online customer portal at https://www.teledynemarine.com/support/RDI/technical-manuals to download manuals or other Teledyne RDI documentation.

Ocean Surveyor/Observer Installation Guide

Ocean Surveyor/Observer Deployment Guide

Set Up the Ocean Surveyor/Observer

Use Figure 5 (RS-232) or Figure 6 (RS-422) to connect the Ocean Surveyor/Observer to a computer for a bench test. Read and follow the cautions listed below *before* applying power to the Ocean Surveyor/Observer.

To connect the I/O cable:

1. Verify the O-ring on the end-cap connector (2-020) and the wet end of the cable (2-022) are both installed.
2. Rotate the cable connector to align the key and pins and then insert it into the receptacle.
3. Push straight in to fully seat the connector.
4. Thread the coupling ring onto the receptacle to complete the connection.

Complete the ground path. The power cord and the outlet used must have functional grounds. Before main power is supplied to the Ocean Surveyor/Observer, the protective earth terminal of the instrument must be connected to the protective conductor of the mains power cord. The mains plug shall 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.

If the instrument power is supplied via an auto-transformer, make sure the common terminal is connected to the earth terminal of the power source.

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.

Do not operate the Ocean Surveyor/Observer Electronics Chassis in the presence of flammable gasses or fumes. Operation of any electrical instrument in such an environment constitutes a definite safety hazard.

Do NOT ping the Ocean Surveyor/Observer with the transducer in air. The power assembly board will short, causing the electronics chassis to no longer communicate. The transducer is pinged by sending a CS or PT5 command or if *VmDas* is started for collecting data – either of these methods will cause damage if the transducer is in air.

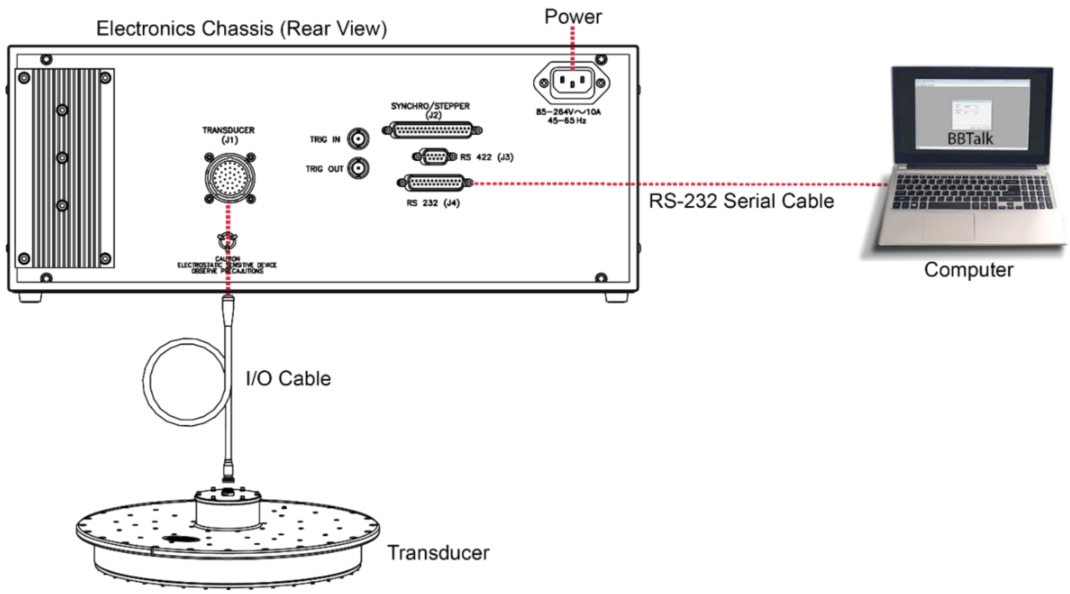


Figure 5. Ocean Surveyor/Observer RS-232 Serial Connections

For serial cables that are 15 meters or less in length, use RS-232.

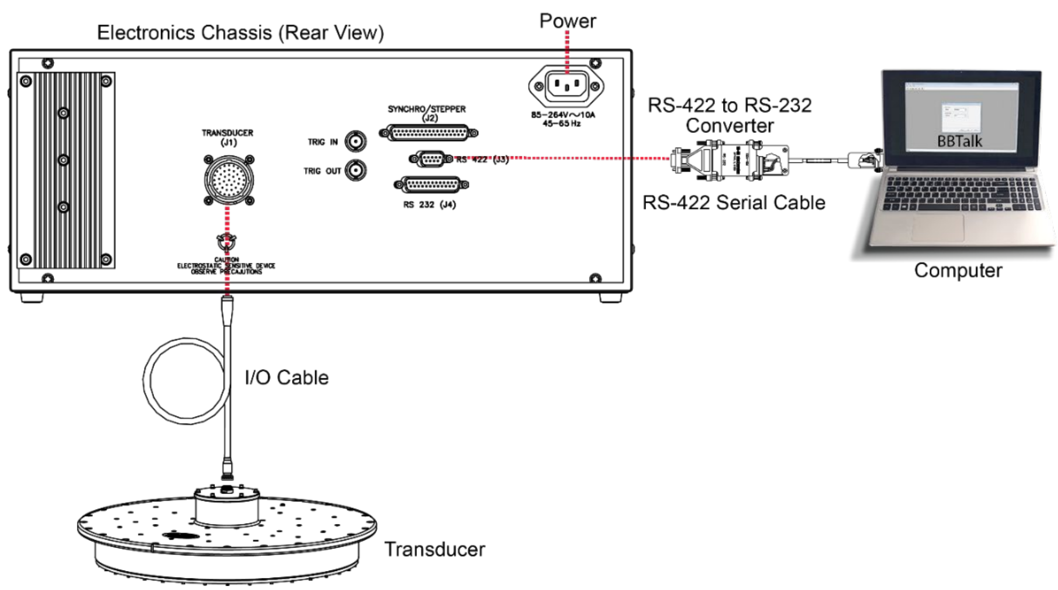


Figure 6. Ocean Surveyor/Observer RS-422 Serial Connections

For serial cables over 15 meters long, use RS-422. See Serial Data Communications Cables for wiring information.

Establish Communications

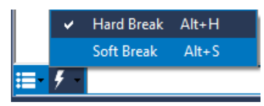
To establish communications with the Ocean Surveyor / Observer:

1. Connect the system and apply power.
2. Start the *TRDI Toolz* software.
3. Select **New Serial Connection**.
4. Enter the ADCP's communication settings. Select the **COM Port** the serial cable is connected to and set the **Baud Rate** from the drop-down lists.

If you are unsure of the ADCP's baud rate, use **Tools**, **Find ADCP**. *TRDI Toolz* will try different baud rates until it connects to the ADCP.

```
>{¡┐φ²∩╜╜²²jñ~ªñδgJ Checking 9600 baud rate
Checking 115200 baud rate
==
Broadband ADCP Version 23.xx
Teledyne RD Instruments (c) 2006
All Rights Reserved.
>
```

5. Click the **Connect** button. Once connected, the button will change to **Disconnect**.
6. Click the **Break** ( ) button. From the **Break** button drop down menu, select **Hard Break**. The wakeup banner will display in the terminal window.




```
[[BREAK Wakeup A]
Broadband ADCP Version 23.xx
Teledyne RD Instruments (c) 2006
All Rights Reserved.
>
```

A delay of up to three seconds before the message appears is normal.

Check the following items if the wake-up message does not appear:

1. Is the I/O cable connected from your computer's COM port to the Ocean Surveyor/Observer electronic chassis?
2. Is power connected to the electronic chassis?
3. Check the communication setup using *TRDI Toolz*. The computer and the Ocean Surveyor/Observer must be using the same baud rate and COM port.
4. If wakeup still does not occur, use the Troubleshooting section to locate the problem.

NOTES

Chapter 2

MAINTENANCE

In this chapter, you will learn:

- Where parts are located
- How to inspect the transducer and I/O cable
- How to replace boards in the electronic chassis and transducer
- Periodic maintenance
- Ocean Observer compass calibration

Maintenance Schedule

To ensure that you continue to receive optimal results from your Teledyne RD Instruments product(s), TRDI recommends that every Ocean Surveyor / Ocean Observer be returned to our factory for an inspection every three to five years. We'll provide your unit with a thorough multi-point inspection, and let you know if any refurbishment services are required to properly maintain the unit. To learn more about this service, please contact field service.

Inspect the Ocean Surveyor / Ocean Observer to spot problems:

Item	TRDI Recommended Period
Transducer Face	The urethane coating is important to Ocean Surveyor / Ocean Observer watertight integrity. Many users are not familiar with the early signs of urethane failure. The primary damage to the urethane is from bio-fouling and long exposure to the water and sun. Damage occurs on the surface of the urethane and at the edge where the urethane bonds to the edge of the transducer face. Mishandling, chemicals, abrasive cleaners and excessive depth pressures can also damage the transducer ceramics or urethane coating. Before each deployment, check the urethane coating on the transducer faces for dents, chipping, peeling, urethane shrinkage, hairline cracks and damage that may affect watertight integrity or transducer operation. **Based on experience, TRDI knows that most systems need to have the urethane inspected after three to five years of field use; shorter periods may be required depending on marine growth.**
O-rings	O-rings on the transducer cable and connector must be carefully checked/replaced **each time the cable is connected or disconnected**. End-Cap/Top Hat O-rings should be replaced whenever the system is opened and BEFORE they are showing any signs of wear and tear. **All O-rings should be replaced every one to two years maximum.**
Hardware (bolts, etc.)	Check all bolts, washers and split washers for signs of corrosion before each deployment. **TRDI recommends replacement every year.** Damaged hardware should never be used.
Zinc Anodes	Inspect the anodes (available on aluminum systems only) before each deployment for wear around the mounting bolts. Cover bolts with silicone sealant prior to deployment. Replace anodes whenever the mounting bolt is in less than 75% in contact with the anode. **Replace all anodes every one to two years maximum.**
Cables and Connectors	Check the transducer I/O connector for cracks or bent pins **each time the cable is connected or disconnected**. Repair of the I/O connector should only be done by TRDI. Check the I/O cable connector for cracks or bent pins. Inspect the full length of the cable for cuts, nicks in the insulation, and exposed conductors before each deployment. Check the Electronic Chassis connectors on the rear panel for cracks or bent pins. Repair of the Electronic Chassis connectors should only be done by TRDI.

Parts Location Drawings

This section is a visual overview of the inside and outside parts of the ADCP. Use the following figures to identify the parts used on your system.

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

Electronic Chassis Part Location

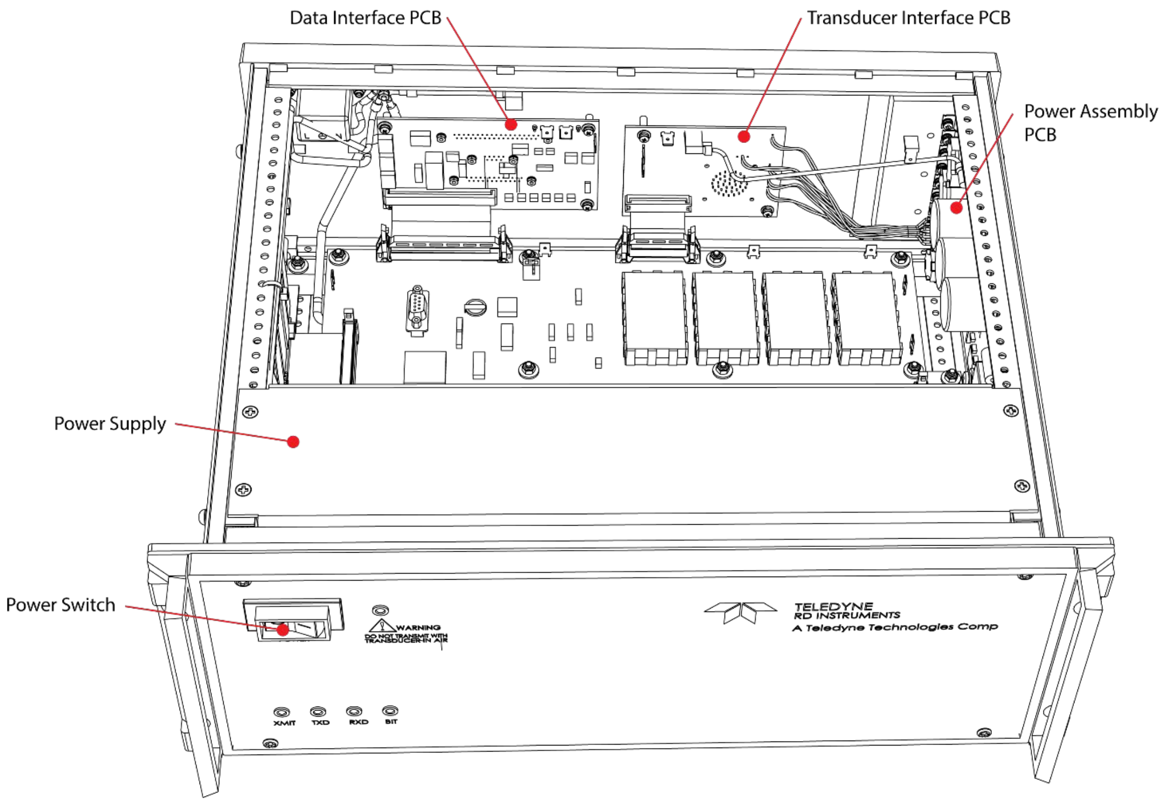


Figure 7. Electronic Chassis (Top View) with Cover Removed

A grounding wire is attached to the underside of the top cover. Unplug the ground wire from the tab on the top cover and then lift off the cover.

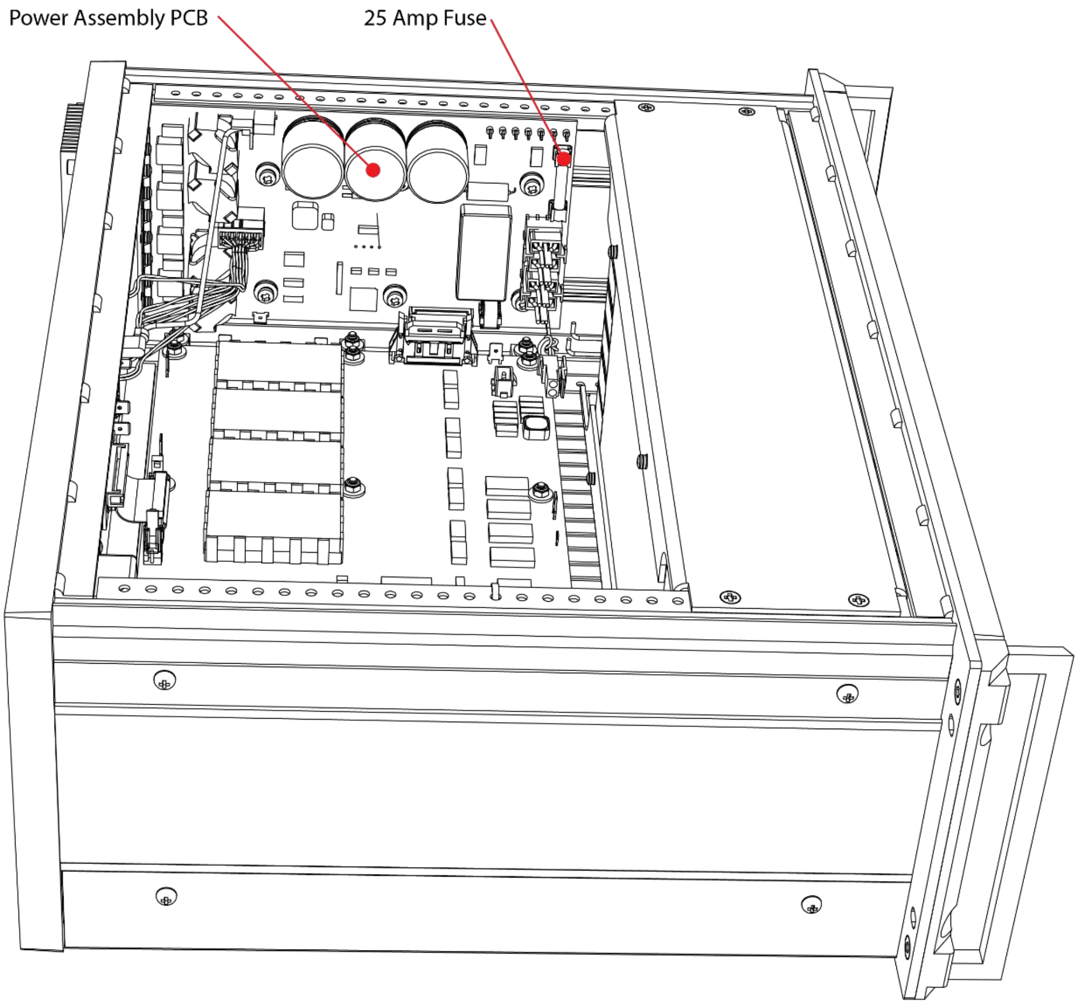


Figure 8. Electronic Chassis (Right View - Looking Toward the Power Assembly PCB)

Transducer Part Location

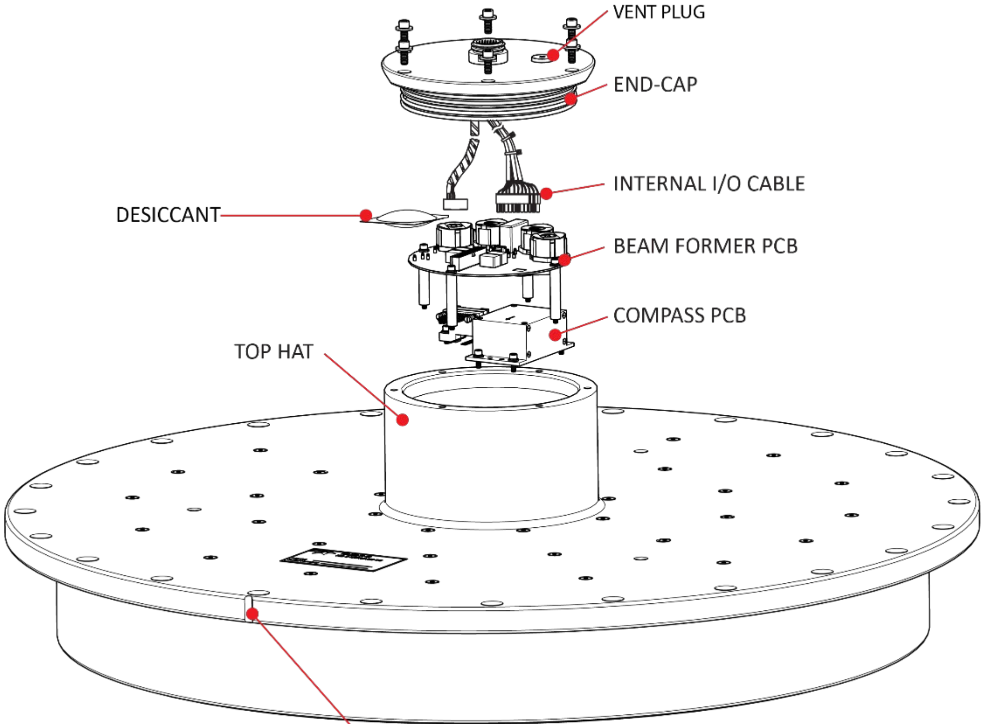


Figure 9. Transducer PCB Layout (38 kHz Round Transducer Shown)

Shock Hazard!

Always treat the array as if it is charged. The array may hold a residual charge created by even minor temperature or pressure changes.

Do not come in contact with any traces on the beamformer board while the P1, P2, P3, and P4 row and column cables are connected.

Once the 17-pin Hypertronics cable is removed, use caution to not come in contact with the pins on the connector.

Do not remove the Vent Plug unless it is time for the O-Ring replacement. **All O-rings should be replaced every one to two years maximum.** See Table 5 for O-Ring replacement part numbers.

The I/O connector on the transducer uses a 2-020 O-ring and the I/O cable (wet end) uses a 2-022 O-ring. **Always check that both O-rings are in place when connecting the I/O cable to the transducer.** The 2-022 O-ring has a tendency to fall out if the cable connector is dropped. If either of these O-rings are missing or damaged, the transducer will flood.

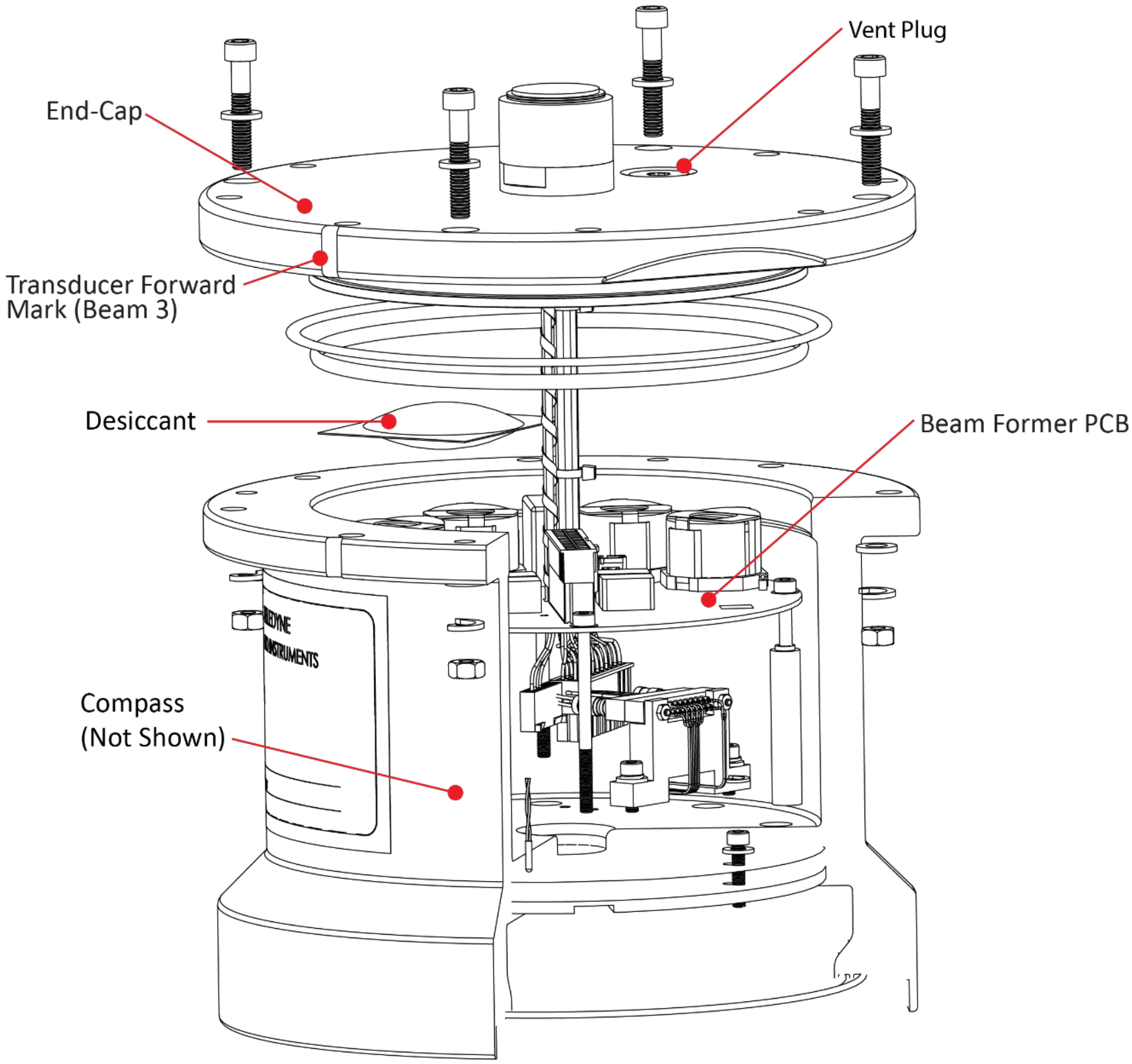


Figure 10. Transducer PCB Layout (150 kHz Transducer Shown)

Shock Hazard!

Always treat the array as if it is charged. The array may hold a residual charge created by even minor temperature or pressure changes.

Do not come in contact with any traces on the beamformer board while the P1, P2, P3, and P4 row and column cables are connected.

Once the 17-pin Hypertronics cable is removed, use caution to not come in contact with the pins on the connector.

Do not remove the Vent Plug unless it is time for the O-Ring replacement. **All O-rings should be replaced every one to two years maximum.** See Table 5 for O-Ring replacement part numbers.

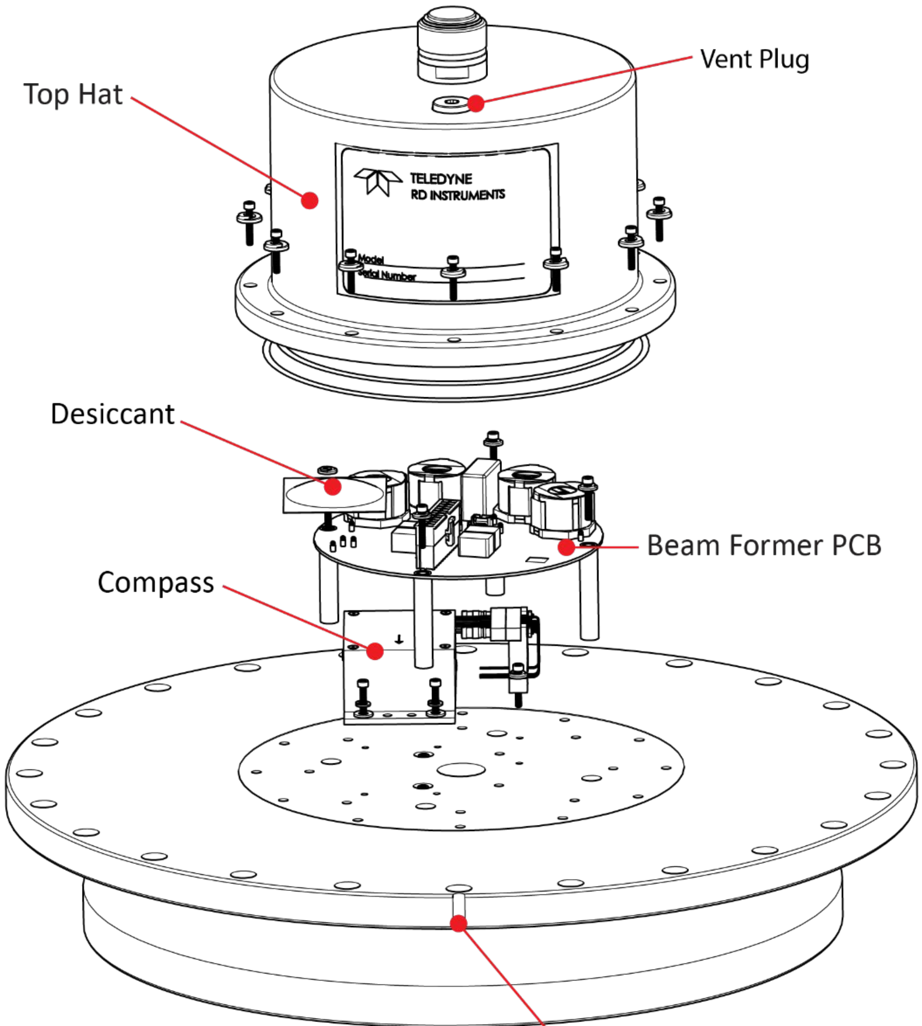


Figure 11. Transducer PCB Layout (75 kHz Transducer Shown)

Shock Hazard!

Always treat the array as if it is charged. The array may hold a residual charge created by even minor temperature or pressure changes.

Do not come in contact with any traces on the beamformer board while the P1, P2, P3, and P4 row and column cables are connected.

Once the 17-pin Hypertronics cable is removed, use caution to not come in contact with the pins on the connector.

Do not remove the Vent Plug unless it is time for the O-Ring replacement. **All O-rings should be replaced every one to two years maximum.** See Table 5 for O-Ring replacement part numbers.

Transducer O-Ring Part Location

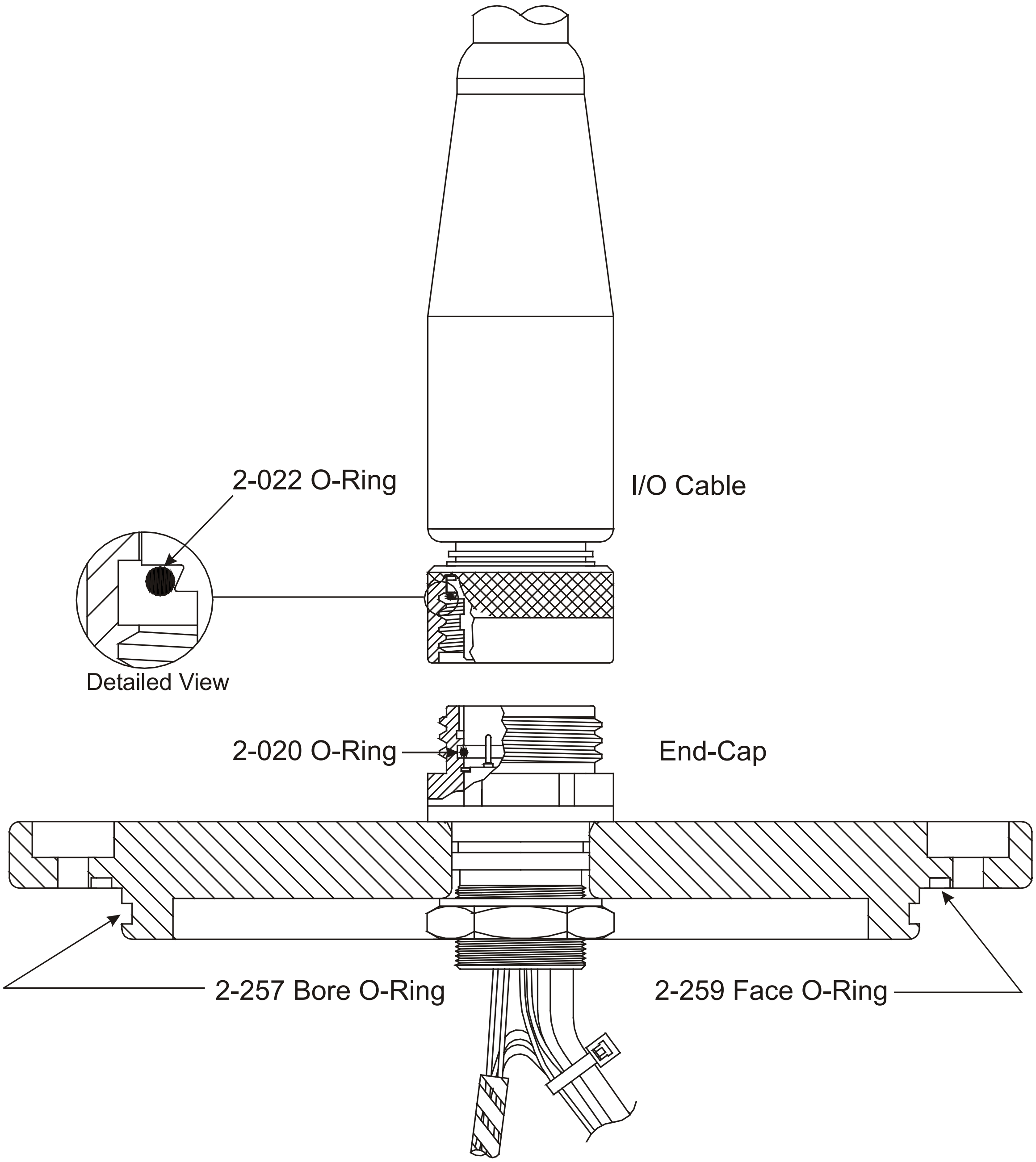


Figure 12. Ocean Surveyor/Observer 38kHz O-ring Locations (Early Phase 2 Builds)

If your end-cap uses eight holes rather than six, the face O-ring is 2-164 and the bore O-ring is 2-256. See Table 5 for O-Ring replacement part numbers.

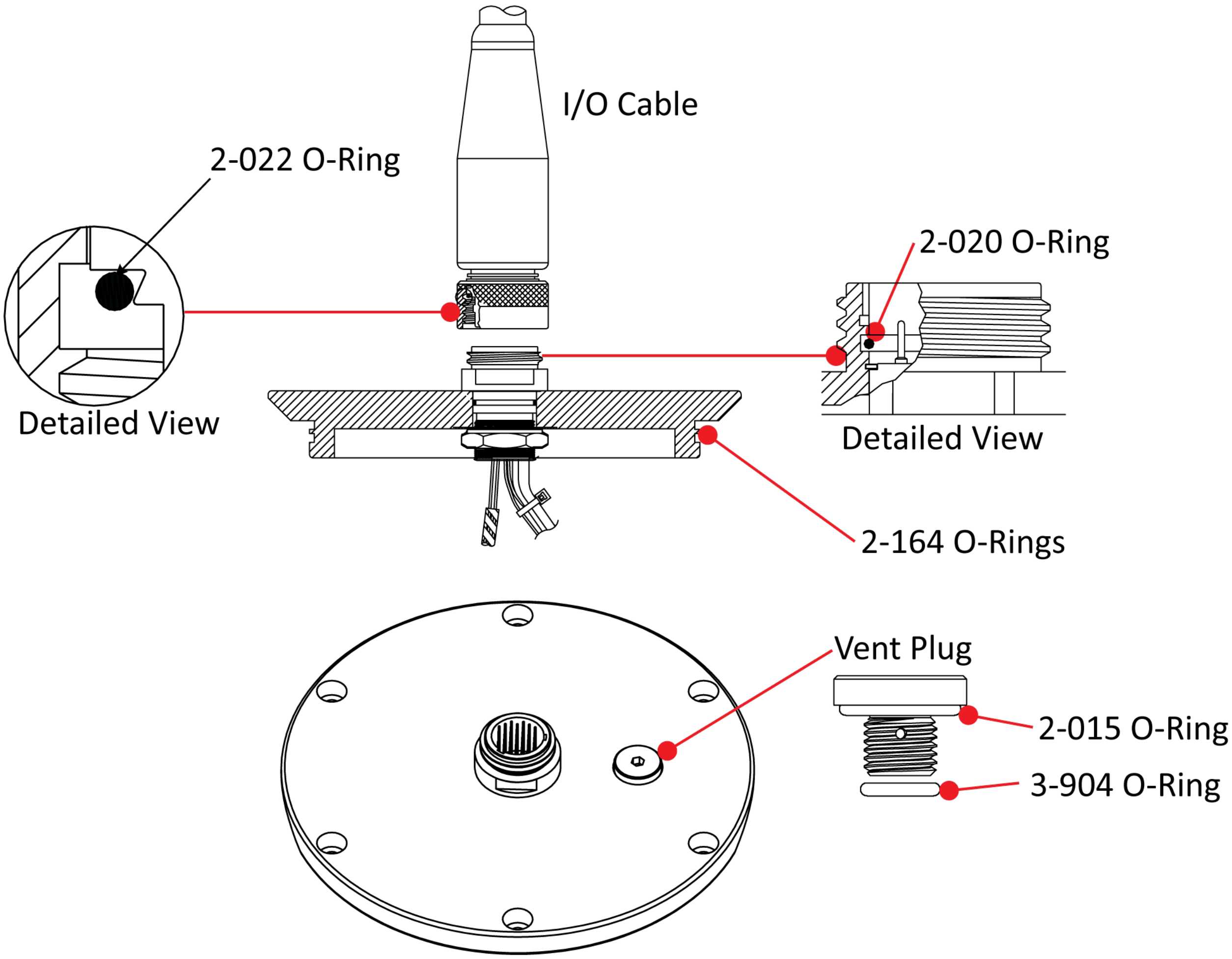


Figure 13. Ocean Surveyor/Observer 38kHz O-ring Locations (Standard Phase 2 Builds)

Do not remove the Vent Plug unless it is time for the O-Ring replacement. **All O-rings should be replaced every one to two years maximum.** See Table 5 for O-Ring replacement part numbers.

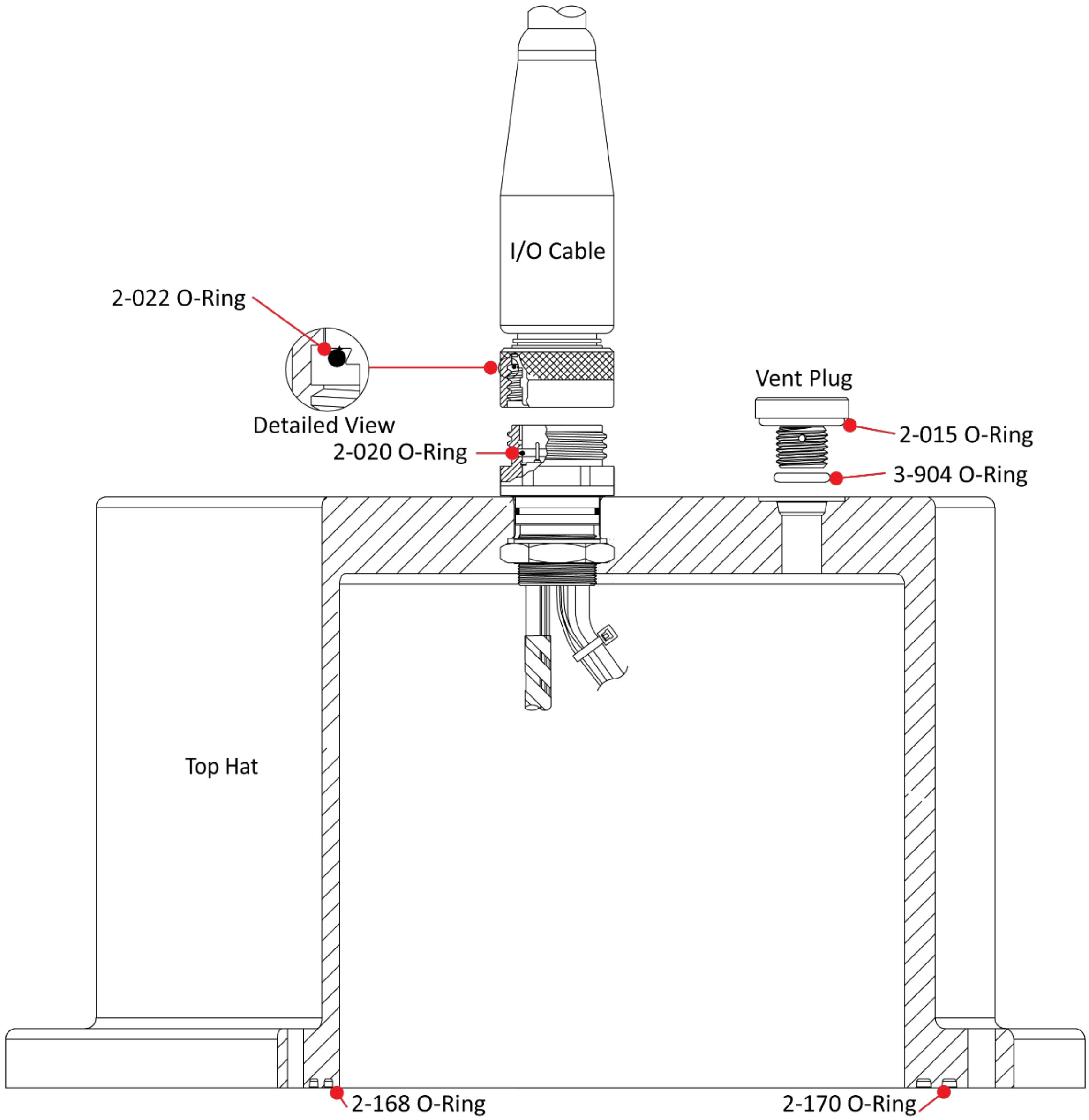


Figure 14. Ocean Surveyor/Observer 75kHz O-ring Locations

Do not remove the Vent Plug unless it is time for the O-Ring replacement. **All O-rings should be replaced every one to two years maximum.** See Table 5 for O-Ring replacement part numbers.

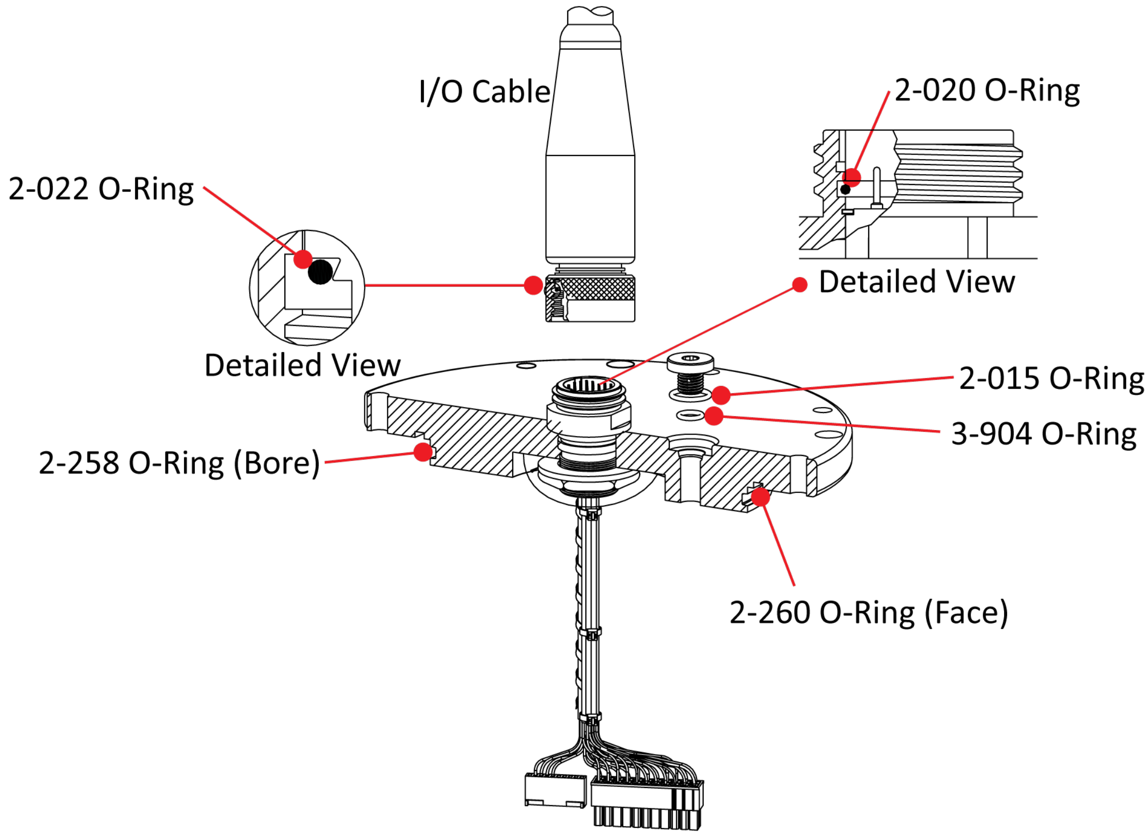


Figure 15. Ocean Surveyor/Observer 150kHz O-ring Locations

Do not remove the Vent Plug unless it is time for the O-Ring replacement. **All O-rings should be replaced every one to two years maximum.** See Table 5 for O-Ring replacement part numbers.

Spare Parts

The following parts are included in the spare parts kit:

Table 4: Spare Parts

Item ID	Description	Where Used
97Z-6017-00	2-020 O-ring	End-Cap/Top Hat connector
97Z-6019-00	2-022 O-ring	I/O Cable wet end connector
5020	Lubricant, silicone	O-ring lubricant
314025	Fuse, 25A Fast blow, 3AB	Power Assembly PCB
M4x0.7x6PH	Screw, pan head, SST	Electronic Chassis cover

TRDI recommends that the Top Hat/End-Cap and Vent Plug O-rings be replaced whenever the transducer assembly is opened. These O-rings are not included in the spare parts kit. See Table 5 for O-Ring replacement part numbers.

Make sure you have replacement parts before opening the transducer.

Table 5. O-Ring Replacement Part Numbers

Item ID	Description	Were Used
97Z-6017-00	2-020 O-ring	End-Cap/Top Hat connector*
97Z-6019-00	2-022 O-ring	I/O Cable wet end connector*
97Z-6084-00	O-RING, 2-015 .070DIAX.551 ID, EPDM, DURO 90A	Vent Plug
97Z-6084-01	O-RING, 3-904, .072DIAX.351 ID, EPDM, DURO90A	Vent Plug
97Z-6038-00	O-RING, 2-168, DURO 70, EPDM	75kHz Top Hat, Inner Ring
97Z-6039-00	O-RING, 2-170, 70 DURO, EPDM	75kHz Top Hat, Outer Ring
97Z-6052-00	O-RING, 2-260, DURO 70, EPDM	150 kHz end-cap, Face
97Z-6050-00	O-RING, 2-258, 70 DURO, EPDM	150 kHz end-cap, Bore
97Z-6034-00	O-RING, 2-164, DURO 70, EPDM	38 kHz standard build **
97Z-6051-00	O-RING,2-259, DURO 70 EPDM	38 kHz early build, Face
97Z-6049-00	O-RING, 2-257, DURO 70, EPDM	38 kHz early build, Bore
97Z-6048-00	O-RING, 2-256, DURO 70, EPDM	38 kHz early build, Bore **

* Included in the spare parts kit.

** If your 38 kHz phase two early build system end-cap uses eight holes rather than six, the face O-ring is 2-164 and the bore O-ring is 2-256.

Inspecting the Transducer and I/O Cable

Based on experience, most Ocean Surveyor/Ocean Observer instruments need to have the urethane inspected after 2 to 3 years of field use. Many users are not familiar with the early signs of urethane failure. The primary damage to the urethane is from bio-fouling and long term exposure to water and the sun. Damage occurs on the surface of the urethane and at the edge where the urethane bonds to the housing. By returning the system every 2 to 3 years, TRDI can inspect it for early signs of urethane failure and repair it through our Refurbishment Service. At the same time, we will make any necessary upgrades to boards, assemblies, and firmware. If the Refurbishment Service is not needed, TRDI can upgrade your system as part of one of our Inspection Services. With proper care, general maintenance, and this routine service period, you will ensure that your ADCP lasts for a minimum of 10 years with no loss in performance. For further information on Services offered please contact the Customer Service department.

Inspect the ADCP to spot problems before each deployment:

- Check the urethane coating on the transducer face for dents, chipping, peeling, urethane shrinkage, hairline cracks and damage that may affect watertight integrity or transducer operation (see Parts Location Drawings).

> Never set the transducer on a rough surface; always use soft padding no thicker than 1/4" to protect the transducers. Thicker padding may allow the transducer face to flex, causing the ceramics to crack.

> The urethane coating is important to ADCP watertight integrity. Mishandling, chemicals, abrasive cleaners and excessive depth pressures can damage the transducer ceramics or urethane coating. Repair of the transducer faces should only be done by TRDI.

- Check the I/O connector for cracks or bent pins (see Parts Location Drawings).

> Repair of the connectors should only be done by TRDI.

- Check the I/O cable connector for cracks or bent pins.
- Inspect the full length of the I/O cable for cuts, nicks in the insulation and exposed conductors.
- Check all bolts, washers, and split washers on the end-cap/top hat for signs of corrosion. Replace if needed.

> The I/O connector on the transducer uses a 2-020 O-ring and the I/O cable (wet end) uses a 2-022 O-ring. **Always check that both O-rings are in place when connecting the I/O cable to the transducer.** The 2-022 O-ring has a tendency to fall out if the cable connector is dropped. If either of these O-rings are missing or damaged, the transducer will flood.

Electronics Chassis Board Replacement

Printed Circuit Board (PCB) removal and replacement may occur during system upgrades. Damage to the board or its components can occur if you do not follow the guidelines in this section. Refer to Figure 7 and Figure 8.

Static electricity can damage board components. TRDI recommends using an earth-grounded wrist strap to help prevent such damage. You must have the wrist strap on whenever you handle a board.

1. Turn off power to the electronic chassis. Disconnect the power to ensure that no power is applied.
2. Remove the Electronics Chassis top cover. The cover is held in place with four screws on the corners of the cover. Remove all screws and lift the cover slowly.

   Do not break the grounding wire attached to the cover.

3. A grounding wire is attached to the underside of the top cover. Unplug the ground wire from the tab on the top cover and lift off the cover. You now have access to the electronic chassis circuit boards.
4. Attach an earth-grounded wrist strap. Locate the board needing removal. Disconnect all cables going to the board. Remove the board.

   Save all hardware.

5. Install the new board. Reconnect all cables.

   Replace all hardware that was removed (i.e. flat washers, split-lock washers, screws, etc.).

   Removing and replacing the Power Assembly Board is not easy. TRDI does not recommend replacing this board in the field.

   The LCD Display is part of the Front Panel Interface PCB. Removing this board requires removing the front cover and unplugging the AC power wires to the power switch. It is critical that the wires to the power switch be plugged back in correctly. TRDI does not recommend replacing this board in the field.

6. Plug the ground wire to the tab on the top cover. Replace the chassis top cover.

Transducer Board Replacement

Access to the Printed Circuit Boards (PCB) in the transducer is not normally required for routine maintenance. TRDI does not recommend opening the transducer housing unless necessary. Damage to the board or its components can occur if you do not follow the guidelines in this section.

Static electricity can damage board components. TRDI recommends using an earth-grounded wrist strap to help prevent such damage. You must have the wrist strap on whenever you handle a board.

Spare O-rings and desiccant must be ordered to properly seal the transducer. Ensure you have these parts before you open the transducer.

Removing the End-Cap or Top Hat

To remove the End-Cap or Top Hat:

1. Remove the external I/O cable. Do not allow debris or moisture to enter the contacts or O-ring surfaces of the connector. Install the dummy plug to protect the connector.
2. Use a marker pen on the end cap/Top Hat assembly to note the transducer forward mark. When you reassemble the transducer, you need to put the end cap/Top Hat assembly back in the same position.
3. Remove the end-cap or Top Hat (75 kHz) assembly on the transducer. The end cap is attached to the beamformer board and TCM2 compass (Ocean Observer system only) by a cable. The end-cap cannot be removed until the cable has been disconnected (see Figure 9 through Figure 15).

Replacing the Beamformer Board

Shock Hazard!

Always treat the array as if it is charged. The array may hold a residual charge created by even minor temperature or pressure changes.

Do not come in contact with any traces on the beamformer board while the P1, P2, P3, and P4 row and column cables are connected. Once the cables are disconnected it is safe to remove the board.

To replace the beamformer board:

1. Attach an earth-grounded wrist strap.
2. Remove the end-cap or top hat.
3. Disconnect the internal I/O cable from the Beamformer PCB.
4. Disconnect the P1, P2, P3, and P4 row and column cables and the ground wires (see Figure 16).

   Shock Hazard!

   Always disconnect the P1 through P4 cables before removing the Beamformer PCB. The array may hold a residual charge.

5. Disconnect the P5/Temp cable from the center of the Beamformer PCB.

6. Remove the old desiccant bag.
7. Remove the four 8-32 socket head screws / flat washers / split washers holding the Beamformer board in place. Carefully lift the beamformer board up and disconnect the 17-pin Hypertronics connector by turning the knobs to release the locking mechanism and then pulling the two apart.
8. The smaller connector from the end-cap is plugged into the compass (Ocean Observer system only). The top cover of the compass box must be removed in order to unplug the connector from the TCM2 PCB.
9. Set the end-cap and old beamformer PCB aside on a soft pad.

Install the new beamformer PCB and connect the cables:

1. Reconnect the compass cable (Ocean Observer system only).
2. Thread the P5/TEMP twisted pair through the hole in the center of the beamformer PCB and connect it to J6 TEMP.
3. Use a wire tie to secure the cable on the bottom of the beamformer PCB. Leave enough room for the P1, P2, P3, and P4 cables to be connected.
4. Check the four standoffs are pressed into transducer mounting plate. Gently place the beamformer PCB over the standoffs. Replace the four 8-32 socket head screws / flat washers / split washers holding the Beamformer board in place.
5. Connect P1 to J1 (Brown/Orange wires), P2 to J2 (Red/Yellow wires), P3 to J3 (Green/Violet wires), and P4 to J4 (Blue/gray wires) to the beamformer PCB.

Shock Hazard!

Once the P1, P2, P3, and P4 row and column cables are connected, do not come in contact with any traces on the beamformer board. The array may hold a residual charge.

6. Reconnect the internal I/O cable.
7. Install the end-cap or top hat.

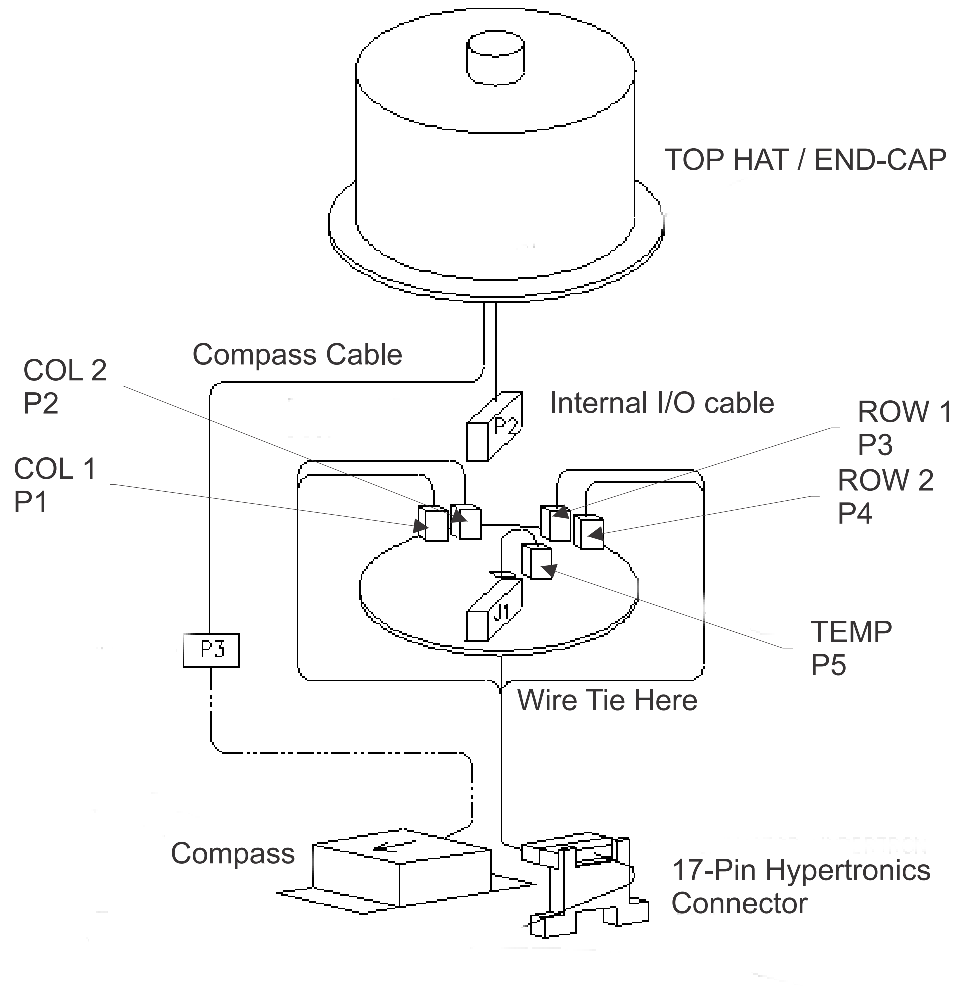


Figure 16. Beamformer Cable Connections

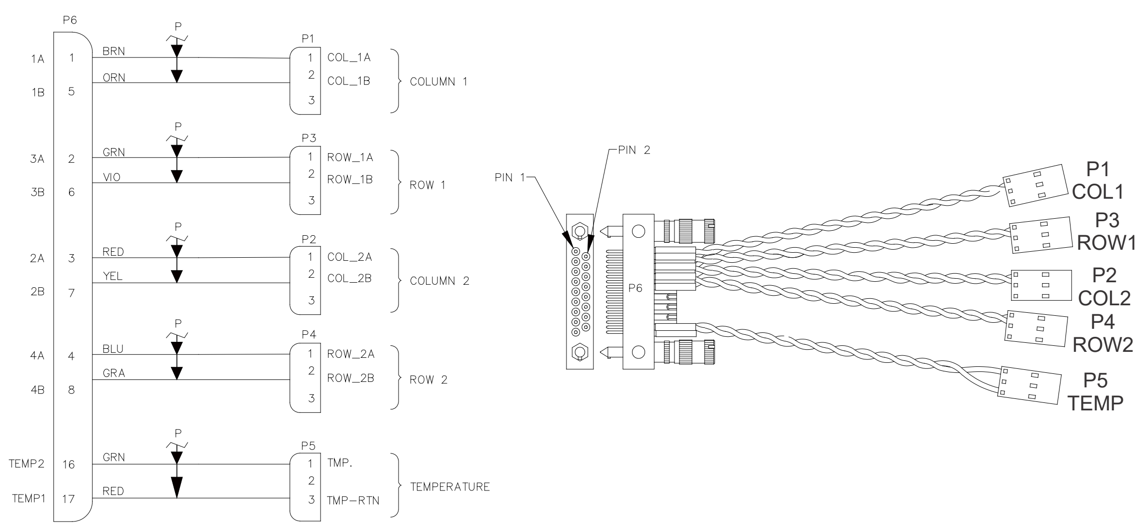


Figure 17. Beamformer Cable

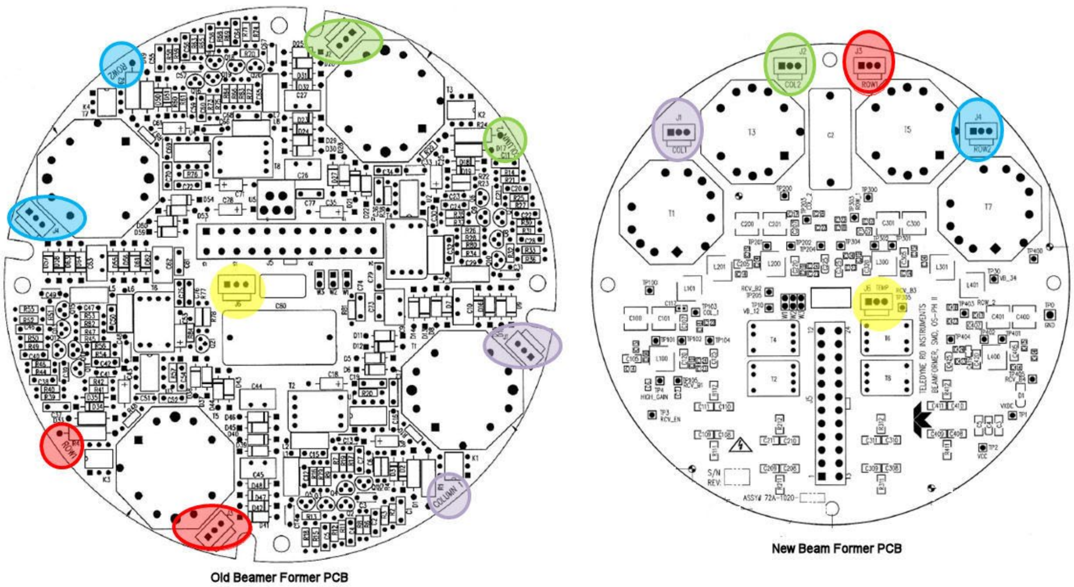


Figure 18. Old versus New Beamformer Cable Connections

Replacing the TCM2 Compass Board

To replace the Ocean Observer TCM2 compass:

1. Attach an earth-grounded wrist strap.
2. Remove the end-cap or Top Hat assembly on the transducer.

> The 75 kHz transducer uses a one-piece Top Hat assembly (see Figure 11)

3. Disconnect the Internal I/O cable from the Beam Former PCB.
4. Remove the Beam Former board to gain access to the cable on the compass.
5. The small connector from the end-cap is plugged into the compass. The top cover of the compass box must be removed in order to unplug the connector from the TCM2 PCB.
6. Remove the four pan head screws holding the compass board in place (see Figure 39).
7. Check the four standoffs are pressed into transducer mounting plate. Gently place the TCM2 Compass PCB over the standoffs. Replace the four pan head screws holding the TCM2 board in place.
8. Reconnect the cable on the TCM2 board and the place the top cover on the compass box.
9. Install the beamformer PCB.
10. Install the end-cap or top hat.

Installing the End-Cap or Top Hat

To install the end-cap or top hat:

1. Before installing the end-cap or Top Hat (75 kHz), check that all cables have been reconnected and all hardware is tight (see Figure 9 through Figure 15).
2. Replace the desiccant (see Desiccant Bags).
3. 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 than 0.1 mm (0.004 in.).

TRDI recommends you use new O-rings if you are preparing for a deployment.

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

4. 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.

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

5. Lubricate the O-ring with a thin coat of silicone lubricant. Apply the lubricant using latex gloves. Do not let loose fibers or lint stick to the O-ring. Fibers can provide a leakage path.

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.

6. Place the end-cap on the transducer housing, aligning the mating holes and the Transducer Forward mark for orientation. When mating the end-cap with the housing, apply equal pressure to all parts of the O-rings. Make sure the face and bore O-rings remain in their retaining grooves.
7. Examine the end-cap assembly bolts and washers for corrosion; replace if necessary. *All* the hardware items are needed to seal the Ocean Surveyor/Observer properly.
8. Install all sets of hardware until “finger-tight.”
9. Tighten the bolts in small increments 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).

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

Do not over tighten the bolts that hold the transducer, housing and end cap together. If you over-tighten, you can crack or break the plastic housing. On the other hand, leaving the bolts too loose can cause the system to flood. Tighten the hardware to 5.6 Nm (50 Pound-Force Inch).

10. There is no need to remove the vent plug. If it is removed, replace the O-rings and tighten the vent plug to the recommended torque value of 6.8 Newton-meters (60 pound-inches).

Periodic Maintenance

Periodic maintenance helps maintain the Ocean Surveyor/Ocean Observer so it is ready for a deployment. Use Table 4 if you need to order replacement parts.

Replacing the Desiccant Bags

Desiccant bags are used to dehumidify the transducer housing interior. The factory-supplied desiccant lasts several years at specified Ocean Surveyor/Observer deployment depths and temperatures. Remember that desiccant rapidly absorbs moisture from normal room air.

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

If the transducer housing has been opened, the desiccant should be replaced.

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.

TRDI recommends that the desiccant and Top Hat O-rings be replaced every three years. These parts are not included in the spare parts kit. Make sure you have replacement parts before opening the transducer.

To replace the desiccant:

1. Remove the End-Cap/Top Hat assembly.
2. Remove the new desiccant bags from the airtight aluminum bag.
3. Remove the old desiccant bag and install a new one. Place the desiccant bag on top of the Beam Former board.

   Shock Hazard!

   Always treat the array as if it is charged. The array may hold a residual charge created by even minor temperature or pressure changes.

   Do not come in contact with any traces on the beamformer board while the P1, P2, P3, and P4 row and column cables are connected.

4. Install the End-Cap/Top Hat assembly.

Replacing the I/O Cable O-Rings

This section explains how to inspect/replace the Ocean Surveyor/Observer O-rings. A successful deployment may depend on the condition of these O-rings and their retaining grooves (see Figure 9 through Figure 15). Read all instructions before doing the required actions.

TRDI strongly recommends replacing these O-rings whenever you connect/disconnect the cable. Inspecting and replacing the O-rings should be the last maintenance task done before installing the transducer.

TRDI recommends that the Top Hat/End-Cap, and Vent Plug O-rings be replaced whenever the transducer assembly is opened. These O-rings are not included in the spare parts kit. Make sure you have replacement parts before opening the transducer.

To replace the I/O Cable O-rings:

1. 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 than 0.1 mm (0.004 in.).
2. 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.
3. Lubricate the O-ring with a **thin** coat of lubricant. Apply the lubricant using latex gloves. Do not let loose fibers or lint stick to the O-ring. Fibers can provide a leakage path.

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.

During installation, do not cut or twist the O-ring. Never force O-rings over sharp corners, screw threads, keyways, slots, or other sharp edges.

4. Use tweezers to install the 2-020 O-ring into the transducer I/O connector. Do not bend the connector pins.
5. Install the I/O cable 2-022 O-ring by first lubricating the O-ring. Do not let lubricant enter the pinholes.

Always check that the I/O cable (wet end) O-ring is in place when connecting the I/O cable to the transducer. The 2-022 O-ring has a tendency to fall out if the cable connector is dropped.

Fuse Replacement

A fuse on the Power Assembly board (see Figure 8) protects the Ocean Surveyor/Observer from excessive incoming power. If this fuse continues to blow, check your input power before applying power again.

To replace the fuse:

1. Turn off the power and disconnect the AC power cord.
2. Remove the top cover of the electronic chassis (see Electronics Chassis Board Replacement). The fuse is located on the Power Assembly board (Figure 8).
3. Gently pull the fuse from the clips.
4. Replace the fuse with the correct voltage and amperage fuse (250 volt 25 amp, fast blow).

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.

5. Install the top cover of the electronic chassis.
6. Test the system (see Testing the Ocean Surveyor/Observer).

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 water. This means all vessel-mounted deployments are subject to biofouling. 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 ADCP. Therefore, you should take steps to prevent biofouling during shallow water deployments.

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. If using antifouling grease, remove the grease immediately after recovering the ADCP from its deployment. Remove the grease with soapy water because cleaning solvents may also cause the urethane to crack. Be sure to wear protective gloves and a face shield.

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

The following options can help reduce biofouling:

1. Cover the transducer face using the recommended antifouling paint.
2. Apply 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.
3. Using an acoustic window over a sea chest filled with fresh water (see the Installation Guide). The drawback to this method is that it reduces the range of the ADCP.

If using antifouling grease, remove it immediately after recovering the ADCP.

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.

Do not coat the transducer face with paints such as copper, chrome, or arsenic. These paints advance the corrosion of the aluminum case and transducer assembly.

All US coastal states prohibit the use of tributyl-tins (TBT) paint. 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.

Never use anti-foulant paints containing copper. They will cause the urethane to separate from the transducer.

Antifouling Paint Recommendations

You can use almost any EPA approved anti-fouling paint on the housing and the urethane transducer faces. Contact the antifouling paint manufacturer for preparation and application procedures for this and other antifoulant paints. Interlux is one source of antifouling paint. Contacting this company is done with the knowledge that Teledyne RD Instruments is not recommending them, but only offering this as a source for the anti-fouling paint.

Manufacturer	Contact
Courtalds Finishes	Telephone: +1 (800) 468-7589
Interlux brand paints	Web Page : http://www.yachtpaint.com/usa/

Brass and Bronze Instruments

Use the following procedure on instruments with brass and bronze cases.

Metal Surfaces

1. Metal Surface Preparation:
    - Thoroughly clean the areas to be painted with soapy water and dry before applying the anti-fouling paint.
    - Clean surface with 353/354 Vinylux solvent (thin with 355 as needed). Perform the Metal Surface Application (Step (b), below) between 1 and 24 hours.
2. Metal Surface Application:
    - Apply a barrier coat of 360R Underwater Metal Primer to all exposed brass. Allow the primer to dry for 5 to 8 hours before proceeding.
    - Mask as necessary to avoid having the cuprous oxide antifouling paint come in contact with any bare metal surfaces.
    - Apply cuprous oxide 669 antifouling paint as desired. If more than one coat is used, allow each coat to dry for 16 hours.

Transducer Face

As originally manufactured, the transducer face has a smooth surface which makes it inhospitable for most biofouling to develop. Preserving this smooth surface is an effective way to prevent heavy biogrowth on the transducer face. However, if an antifouling coating is desired on the transducer face, then the face must be lightly abraded to allow for the antifouling coating to adhere. **As a rule, the surface must be kept smooth unless an antifouling coating will be applied.**

The following tips are only general recommendations. Always follow the anti-fouling paint manufacturer's instructions on how to apply the anti-fouling paint.

1. Surface Preparation - Lightly abrade the surface using Scotch Brite® to remove gloss. Thoroughly clean the areas to be painted with soapy water and dry.
2. Surface Application:
    - Mask as necessary to avoid having the cuprous oxide antifouling paint come in contact with any bare metal surfaces.
    - Apply a thin barrier coat of 360R Underwater Metal Primer. Allow the primer to dry for 5 to 8 hours before proceeding.
    - Apply cuprous oxide 669 antifouling paint. Do not exceed the maximum thickness specified in Table 6. If more than one coat is needed to reach the maximum thickness, allow each coat to dry for 16 hours.
    - When applying paint to the urethane faces, use extra caution to apply a smooth, thin coat of paint.

Table 6: Recommended Maximum Thickness of Cuprous Oxide 669 Paint

System Frequency	Maximum Paint Thickness*
38 kHz	1.00 mm (0.040 in.)
75 kHz	1.00 mm (0.040 in.)
150 kHz	0.50 mm (0.020 in.)

Cuprous oxide 669 is a high-density paint. As such, using it will slightly degrade ADCP performance. Exceeding the recommended maximum thickness would further degrade performance.

Read the Material Safety Data Sheet before using any of the listed solvents and paints.

Using antifouling paints may be appropriate if you cannot clean the ADCP regularly (weekly). Be aware that antifouling paints can accelerate the corrosion of aluminum housings, and can initiate dezincification corrosion of brass. Once initiated, dezincification will rapidly destroy the transducer.

Some antifouling coatings may not be legal for use in all areas. Check with your local environmental agency before using the antifouling paint.

Removal of Biofouling

To remove foreign matter and biofouling:

1. Remove soft-bodied marine growth or foreign matter with soapy water. Waterless hand cleaners remove most petroleum-based fouling.

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. The urethane coating on the transducer faces could be damaged.

If there is heavy fouling or marine growth, the transducer face may need a thorough cleaning to restore acoustic performance. Barnacles do not usually affect ADCP operation, but TRDI does 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.

If barnacles have entered more than 1.0 to 1.5 mm (0.06 in.) into the transducer face urethane, you should send the ADCP to TRDI for repair. If you do not think you can remove barnacles without damaging the transducer face, contact TRDI.

2. Rinse with fresh water to remove soap or Lime-Away® residue.
3. Dry the transducer face with low-pressure compressed air or soft lint-free towels.

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

Compass Calibration

Only Ocean Observer systems use the TCM2 compass and these systems are designed around use on an oil platform. The compass calibration must be performed on **land**, not on the deck of an oil platform. The platform’s motion and magnetic fields will likely prevent successful calibration.

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

Compass calibration requires pitching and rolling the Ocean Observer transducer while rotating in a circle. Protect the ADCP’s transducer faces with a soft pad—never rest the transducer face on rough surfaces. If you are calibrating it the upward direction, you must carry the ADCP while doing the pitch, roll and rotations to protect the I/O cable.

Due to the size and weight of the transducer, the compass calibration it is not recommended for the 75kHz and 38kHz Ocean Observers.

Never set the transducer faces on a hard or rough surface. Protect the urethane faces and I/O cable when rotating the ADCP during calibration.

TCM2 Compass Command Summary

This section defines the commands used by the Ocean Observer’s TCM2 compass. The following commands are used to calibrate the TCM2 compass.

You will not see the command being entered as you type (echo is turned off by default). Remember to press Enter after each command. You may need to press the H (halt) command more than once to stop the continuous output mode.

Table 7: TCM2 Dumb Terminal Commands

Command	Description
&m9	Enables communication access to the TCM2 compass through the RS-485 interface. The command prompt will change from a “>” to a “%” symbol.
cc	Clear calibration data.
AX	Warm reboot (also halts the continuous output mode).
GO	Enter continuous output mode.
H	Halt continuous sampling, enter standby mode.
LC?	Output last calibration score.
MPCAL	Type MPCAL=E to enter the multi-point calibration mode. Type MPCAL=D to disable the calibration mode.
?	Help – all TCM2 commands are displayed.
^e	Control-e enables echoing
^n	Control-n disables echoing

TCM2 Field Calibration Procedure

Only Ocean Observer systems use the TCM2 compass and these systems are designed around use on an oil platform. The compass calibration must be performed on land, not on the deck of an oil platform. The platform's motion and magnetic fields will likely prevent successful calibration.

To calibrate the TCM2 compass:

1. Connect the Ocean Observer to power and a computer as shown in Figure 5 or Figure 6. The compass calibration requires that you send commands directly to the ADCP using *TRDI Toolz*.
2. Start *TRDI Toolz*. Type in the command **&M9** and press the **Enter** key.
3. Type **H** to halt continuous sampling.
4. Type **CC** to clear previous calibration values.
5. Type **MPCAL=E** to enter the multi-point calibration mode.
6. Type **GO** to begin taking calibration samples.
7. Rotate the ADCP approximately one turn per minute while pitching and rolling the Ocean Observer as much as possible. The turn does not have to be a perfect circle. In the calibration mode, the TCM2 is trying to take as many different data points as possible to determine the magnetic anomalies. The more pitch and roll points you give it, the better it is able to determine the vertical magnetic fields. You can exceed the range of the inclinometer (greater than 20°) without effecting the calibration. After rotating the ADCP *at least* once (twice would be better), continue to step 8.

If the ADCP is mounted to a boat or other vehicle, rotate and "rock" the boat.

8. Type **H** to halt acquisition of calibration samples.
9. Type **MPCAL=D** to exit the multi-point calibration mode.
10. Type **LC?** to retrieve the calibration score. The calibration score has the following format: HnVnMn.nn.

The first two numbers in the calibration score, HnVn.nn, respectively describe the quality of the calibration for the horizontal and vertical component of the ADCPs local magnetic fields. Higher numbers (maximum = 9) reflect higher quality. The factors that contribute to a good score for Hn and Vn are:

- A good, magnetically quite location was chosen for the user calibration procedure.
- The magnetic environment around the ADCP is stable — there were no large sources of changing fields during the calibration.
- The calibration data points included a change in the ADCPs inclination to allow for measurement of the vertical distortion field.
- There are no significant soft-iron distortion effects.
- The last number in the score, Mn.nn.nn, describes the magnitude of the local field generated by the ADCP. Larger numbers denote strong local fields. Small local fields are preferable, since less correction will be necessary. Magnitude scores greater than 30.0 indicate strong fields at the TCM2 location, and may warrant investigation. A good reading is below 2.00 with minimal local magnetic disturbances.

As an example, a good calibration score would be H9V9M1.32. A poor score is H5V2M1.32 or H9V2M1.32. If the score is poor, repeat steps 5 through 10. If the score can not be improved, change the location of the ADCP and try the calibration procedure again.

By default the watchdog timer for the electronics will be enabled (jumper W1 on the Electronics Chassis Motherboard). As a result this test will automatically halt after 1 minute. What will be seen is the OS ADCP wake-up message followed by the prompt. To restart the test start at step 8.

If this test must be run continuously then remove jumper W1 on the Electronics Chassis Motherboard to disable the watchdog timer. Remember to place the jumper back in place for normal operation.

11. Type **GO** to enter the continuous output mode, using the corrections.

If you forget this step, the compass will not output any data.

12. Exit *TRDI Toolz*.

NOTES

Chapter 3

TESTING THE OCEAN SURVEYOR/OBSERVER

In this chapter, you will learn:

- Dock side tests
- Sea acceptance tests

Dock Side Tests

This section explains how to test the Ocean Surveyor/Observer. *TRDI Toolz* thoroughly checks the Ocean Surveyor/Observer in a laboratory environment, but is no substitute for the Sea Acceptance Tests. You should do the Dock Side tests:

- When you first receive the Ocean Surveyor/Observer.
- Before and after each deployment or every six months.
- When you suspect instrument problems.

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

Do NOT ping the Ocean Surveyor/Observer with the transducer in air. The power assembly board will short, causing the electronics chassis to no longer communicate. The transducer is pinged by sending a CS or PT5 command or if *VmDas* is started for collecting data – either of these methods will cause damage if the transducer is in air.

The Dock Side checks should occur prior to performing the Sea Acceptance Tests. These tests will verify the Ocean Surveyor/Observer ADCP is ready for the Sea Acceptance Tests and confirm the peripherals attached to the ADCP.

Compare future tests to the Dock Side test results. If large changes have occurred, check to see if changes have been made to the installation (i.e. a new sonar device installed, the Ocean Surveyor/Observer transducer cable or electronic chassis was moved). Changes in the test results do not necessarily mean that the system is failing, but do require further investigation. Perform the Sea Acceptance tests (see Sea Acceptance Tests) to fully evaluate the system performance.

Dock Side Diagnostic Tests

The Ocean Surveyor/Observer ADCP interfaces directly to the computer. The following tests will confirm the connection of the Ocean Surveyor/Observer Electronics Chassis to the Transducer.

Table 8: 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.
Ocean Surveyor/Observer	The Ocean Surveyor/Observer ADCP electronics chassis should be connected to the transducer, and AC Power connected to the electronics chassis
Computer	The TRDI *TRDI Toolz* program should be running, communications port setting (F5) to match the connection to the PC and Ocean Surveyor/Observer ADCP baud rate requirements (default 9600,N,8,1).

Use the following steps to interconnect the Ocean Surveyor/Observer system and to place the ADCP in a known state:

1. Interconnect and apply power to the system as shown in Figure 5.
2. Start the *TRDI Toolz* program.
3. Run the following tests as shown in the next sections.

The built-in tests require you to immerse the transducer faces in water. If you do not, some of the tests may fail.

Do NOT ping the Ocean Surveyor/Observer with the transducer in air. The power assembly board will short, causing the electronics chassis to no longer communicate. The transducer is pinged by sending a CS or PT5 command or if *VmDas* is started for collecting data – either of these methods will cause damage if the transducer is in air.

Do not place the electronic chassis within 3 feet of a computer monitor. Monitors are a major source of electronic interference.

Display System Parameters

This tells the ADCP to display specific information about your ADCP. For example:

```
>PS0
Frequency:  38400 HZ
   Configuration:  4 BEAM, JANUS
 Transducer Type:  PHASED ARRAY
      Beam Angle:  30 DEGREES
    Beam Pattern:  CONVEX
     Orientation:  DOWN
    CPU Firmware:  14.04
     Temp Sensor:  STANDARD
 Attitude Sensor:  NONE
```

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

To check the system configuration using *TRDI Toolz*:

If you have an Ocean Observer skip to step b. If you have an Ocean Surveyor and you are receiving an error message that the TCM2 compass is not detected, then do the following.

1. Start *TRDI Toolz* and press the **End** key to wake the system.
2. Type @C – The ADCP will respond with a configuration list. You will want to ensure that both the TCM2 Detect is DISABLED and that the Platform is set to SHIP. If they are not set properly then follow steps 3 through 6 to set them properly.
3. Type D to access the TCM2 configuration.
4. Type 0 to disable the TCM2 compass.
5. Type P to access the Platform configuration.
6. Type 0 for Ship configuration.
7. Type 1 to Save and Exit.
8. Press End to send a Break to the ADCP.
9. After the wake up message appears, check if the system has been configured properly.

If you have an Ocean Observer and the TCM2 compass is not detected, then do the following.

1. Start *TRDI Toolz* and press the **End** key to wake the system.
2. Type @C – The ADCP will respond with a configuration list. You will want to ensure that both the TCM2 Detect is ENABLED and that the Platform is set to PLATFORM. If they are not set properly then follow steps 3 through 6 to set them properly.
3. Type D to access the TCM2 configuration.

4. Type 1 to enable the TCM2 compass.
5. Type P to access the Platform configuration.
6. Type 1 for Platform configuration.
7. Type 1 to Save and Exit.
8. Press End to send a Break to the ADCP.
9. After the wake up message appears, check if the system has been configured properly.

```
>@C
WARNING:  Changing system configuration may affect performance!
          Know and understand the consequences before changing
          any settings.

System Configuration Menu

     0    Exit without Saving
     1    Save and Exit
     B    Beam Former Rev      A02 or later
     D    TCM/2 Detect         DISABLED
     O    Test Port            DISABLED
     P    Platform             SHIP
     S    Synchro Detect       ENABLED
     X    Transducer Type      ROUND 36x36
     ?    Display Menu
% 1

System Config saved to FLASH
```

If the system is configured properly and you still do not detect the TCM2 compass, see Troubleshooting to determine the failure.

Interference Verification Test

This test checks receive-path characteristics, checks for interference signals in the processing circuitry, and checks gain values. A message similar to the following should appear.

Compare these test results with the dockside tests done when the system was first installed.

```
>PT3
Correlation Magnitude:
      Lag     Bm1       Bm2       Bm3       Bm4
       0      1.00      1.00      1.00      1.00
       1      0.77      0.77      0.78      0.77
       2      0.34      0.34      0.35      0.32
       3      0.05      0.11      0.05      0.04
       4      0.09      0.16      0.09      0.10
       5      0.08      0.13      0.08      0.06
       6      0.03      0.09      0.02      0.02
       7      0.02      0.09      0.02      0.03
RSSI: 13 13 11 14

PASSED

>
```

Interference Test Pass/Fail Conditions - The ADCP pings without transmitting and displays the result of an autocorrelation function performed over 8 lag periods. Ideally, you should see high correlation at near-zero lags, and then decorrelation as the lags get longer. High correlation values at longer lags indicate interference is present.

PT3 Test is considered to have passed if the correlation values at lag 5 and greater are less than 0.50.

Bandwidth Verification Test

This test measures the receive bandwidth of the system.

Compare these test results with the dockside tests done when the system was first installed.

A message similar to the following should appear.

```
>PT6
Receive Bandwidth:
.......................................
  Expected      Bm1    Bm2    Bm3    Bm4
  --------    -----  -----  -----  -----
   15500      14432  14498  15752  15406

PASSED

>
```

The PT6 Test is considered to have passed if the received bandwidth for each beam is within ± 20% of the expected bandwidth.

Dock Side Peripheral Tests

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

Heading can be input and combined with Ocean Surveyor 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 or with PASHR or PRDID strings as specified in the **Transforms** tab in *VmDas*.

Pitch and Roll can be input and combined with Ocean Surveyor data in the computer software *VmDas*. This pitch/roll input is done through the communications port of the computer with the TRDI proprietary NMEA PASHR or PRDID strings.

Navigation data can only be combined with Ocean Surveyor 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.

Table 9: Dock Side Peripheral Tests Setup

Setup	Description
Platform/Vessel	The Navigation, and Pitch/Roll sensors should be attached to the appropriate place on either the Ocean Surveyor electronics chassis or the computer communication port. The devices should be on and should be stable.
Ocean Surveyor	The Ocean Surveyor electronics chassis should be connected to the transducer, AC Power connected to the electronics chassis, and the power switch turned on.
Computer	The *TRDI Toolz* program should be running, communications port setting (F5) to match the connection to the PC and Ocean Surveyor/Observer ADCP baud rate requirements (default 9600,N,8,1).

Testing the Navigation Connections to the Computer

Start *VmDas* in the Data Collect mode (see the *VmDas* User's Guide). 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 (see Figure 19) shows a text box of the position and velocity data from a NMEA navigation device. You can use this to verify the navigation connections.

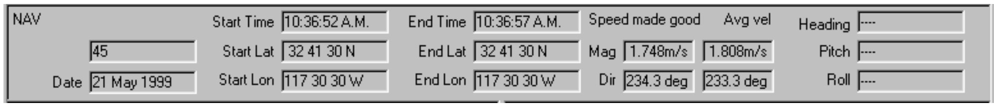


Figure 19. Testing the Navigation Connections

Testing $HDG or $HDT Heading Connections to the Computer

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 $PASHR or $PRDID Heading Connections to the Computer

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 $PASHR or $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.

Table 10: Dock Side Peripheral Test Results

Test	Test Criterion
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.

Sea Acceptance Tests

This procedure is intended to test the Ocean Surveyor/Observer at sea. This procedure assumes that the Dock Side Testing (see Dock Side Tests) 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.

The reason for Sea Acceptance Testing is that although the Dock Side Tests confirm the Ocean Surveyor/Observer 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

- Ocean Surveyor/Observer 38kHz, 75kHz, or 150kHz ADCP with firmware 23.xx or greater
- Computer
- *VmDas* Program
- *WinADCP* Program
- Navigation Interface Connected

- Heading Interface Connected

VmDas Setup

1. Start *VmDas*. On the **File** menu, click **Collect Data**. On the **Options** menu, click **Load**. Select the Default.ini file and click **Open**.
2. On the **Options** menu, click **Edit Data Options**. Click the **ADCP Setup** tab. Set the **Ensemble Time** to the value shown in Table 11.

Table 11: Ensemble Time

Frequency (kHz)	With Bottom Track (sec)	With Out Bottom Track (sec)
38	4	2
75	2	1
150	1	1

3. On the **ADCP Setup** tab, select **Use File**. Use Table 12 to choose a command file for your ADCP, and load it into *VmDas* using the **Browse** button.

Table 12: Command Files

File Name	Description
OS38NBDEF	Default setup for an OS 38kHz ADCP in the lowest precision (narrow bandwidth) but extended range profiling mode.
OS75NBDEF	Default setup for an OS 75kHz ADCP in the lowest precision (narrow bandwidth) but extended range profiling mode.
OS150NBDEF	Default setup for an OS 150kHz ADCP in the lowest precision (narrow bandwidth) but extended range profiling mode.

These files can also be used for stationary systems (such as Oil Rig platforms) but you must first open the file (right click on file and select open) and modify the EZ command from EZ1020001 to EZ1111111 and change the BP command from BP1 to BP0. This new setting will enable the use of the internal heading, pitch, and roll sensors.

4. 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).

Interference Test

The Ocean Surveyor/Observer 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.

Interference Test Platform Test Setup

This test is performed best if the platform is in water deeper than the ADCP's maximum expected profiling range. Use the following table to determine the best water depth. If the water is shallower than 50% of the depths in Table 13, then do not run this test, as the results will be inconclusive.

Table 13: Interference Test Minimum Water Depth Requirement

OS 38 ADCP	OS 75 ADCP	OS 150 ADCP
1200 meters	1000 meters	600 meters

The platform speed for this test is stationary or 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 then the next sonar device is turned on and started pinging for 10 minutes. This process repeats for each of the sonar devices.

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.

How to Identify Interference

If there is an interference term, the echo intensity data will show spurious echo intensity spikes. An example of what an interference term may look like what is shown in Figure 20.

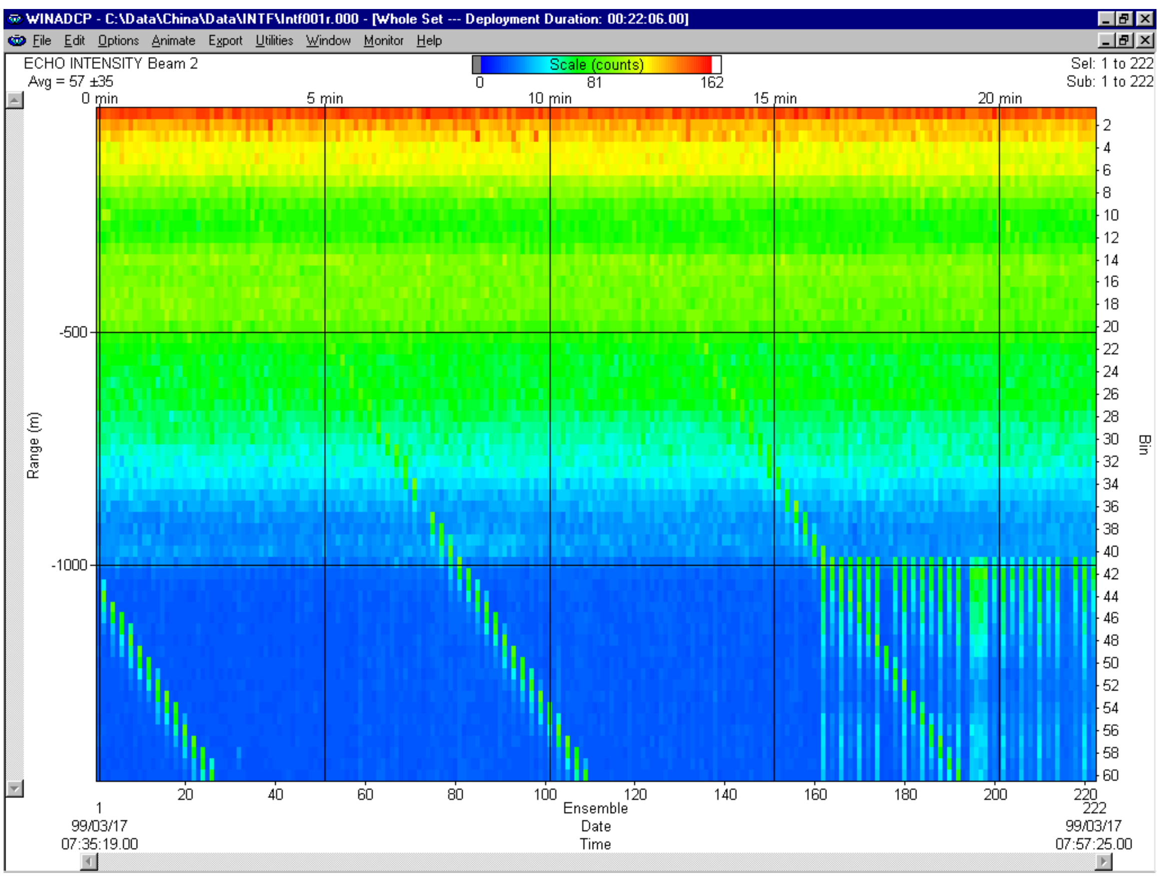


Figure 20. Interference Test

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

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

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.

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 14: Water Profile Range Test Minimum Water Depth

OS 38 ADCP	OS 75 ADCP	OS 150 ADCP
1200 meters	1000 meters	600 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 15: Water Profile Range Test Platform Speed

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

Speeds 2 through 6 are not applicable for Ocean Observers mounted on fixed platforms.

Water Profile Range Computer Screen Display Setup

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

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
Speed 1			
Speed 2			
Speed 3			
Speed 4			
Speed 5			
Speed 6			

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 found in the *VmDas* Tabular display or is calculated as follows: ((bin size) * (last bin number)) + (Blank + Depth of Transducer)
- 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 the platform background noise is variable there should be a speed at which the nominal range of the system is obtained.

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 Ocean Surveyor/Observer frequency is shown in the following table.

Table 16: Required Blanking Distance

Frequency	Typical Blank Period for Ringing
38kHz	16 meters
75kHz	8 meters
150kHz	4 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.

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 17: Ringing Test Water Depth Requirement

OS 38 ADCP	OS 75 ADCP	Ocean Surveyor/Observer 150 ADCP
300-600 meters	200-400 meters	100-200 meters

Platform speed should be held to as fast a speed as possible without losing 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.

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.

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.

Transducer Alignment Test

The mounting alignment of the 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 water the 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 aligned then the both the magnitude and direction of the currents will appear the same in all directions that the platform travels.

Platform Testing Setup

The key to success on this test is that minimal water velocity and direction change over the entire test period. The following test will take a minimum of five hours to collect. This length of time is required in order to obtain enough data samples to reduce the noise sufficiently. This test requires that the platform be within the ADCP bottom tracking range, so that valid bottom track can be used, and that reliable GPS data be available (DGPS is recommended). Use the following table to determine the optimum water depth range required.

Table 18: Transducer Alignment Test Water Depth Requirement

OS 38 ADCP	OS 75 ADCP	OS 150 ADCP
300-600 meters	200-400 meters	100-250 meters

The platform speed is to be held at a constant speed. Any speed between 5 to 10 knots is acceptable, however once a speed is selected then the vessel should maintain that speed during the entire course. The course for this test contains a minimum of five legs. Each leg must be a minimum of 30 minutes long (1 to 2 hours per leg is the optimal time). The course of ship travel is shown in Figure 21. All data must be collected in beam coordinates

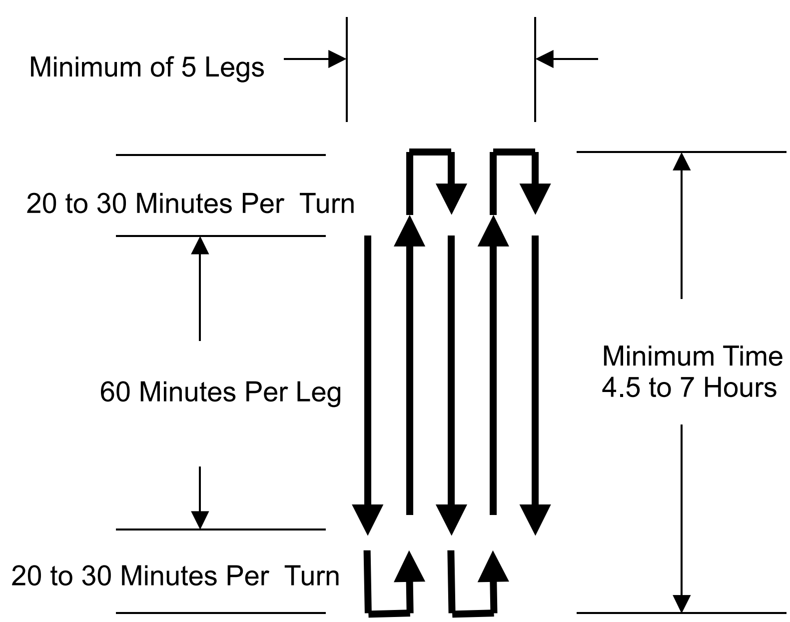


Figure 21. Transducer Alignment Test

Computer Screen Display Setup

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

Each of the vertical lines represents the point when the vessel changed directions.

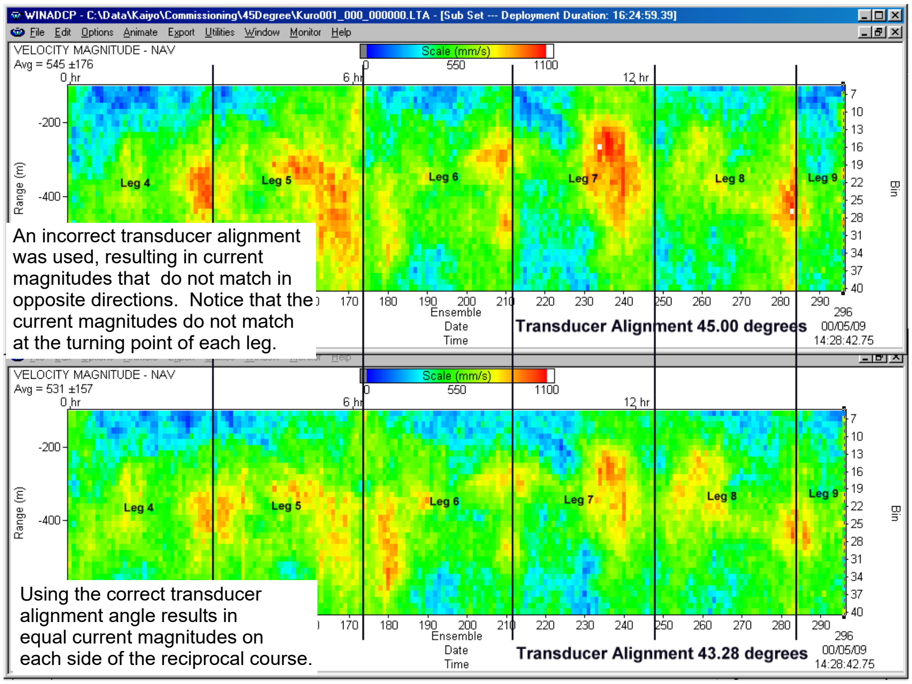


Figure 22. Transducer Alignment Display

Transducer Alignment Results Sheet

A pass condition is if the velocities in each of the ship track plotted directions has the reasonably the same magnitude and direction. It is common to see some wild velocity magnitude and directions. This happens as a result of the effects of the turn on 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 directions then it will be necessary to enter in a transducer misalignment angle. The 5-minute averages of both GPS and Bottom Track Direction are compared in at least 2 of the legs traveled. An average direction along each leg is calculated for both the GPS and Bottom Track data. The difference in the average directions is the misalignment angle.

Record the results of this portion of the Transducer Alignment with Bottom Track Reference with the formula:

Misalignment Angle = (GPS Average Direction) – (Bottom Track Average Direction)

Misalignment Angle Required	Degrees

Changing the transducer alignment angle, reprocessing the data, and finally playing back the same data file again allows you to confirm if the misalignment angle correction is correct. A pass condition is if the velocities in each of the ship track plotted directions has the reasonably the same magnitude and direction. It is common to see some wild velocity magnitude and directions.

Record the results of the verification of the Transducer Alignment with Bottom Track Reference:

Alignment Verification	Pass/Fail

Change the data display reference from bottom track to the navigation data in the VMDAS program. A pass condition exists if little to no change in the velocity magnitude and direction occurred when switching to the navigation data reference

Record the results of this portion of the Transducer Alignment with Navigation Reference:

Navigation Verification	Pass/Fail

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 (see Water Profile Range Test). Use the speed that allowed the nominal water profile range to be obtained or the maximum range if the nominal range was not obtained.

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.

Bottom Tracking Computer Screen Display Setup

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

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.

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.

Chapter 4

TROUBLESHOOTING

In this chapter, you will learn:

- Basic steps in troubleshooting
- Troubleshooting communication failures
- Troubleshooting a built-in test failure
- Troubleshooting a beam failure
- Troubleshooting data problems

Although the Ocean Surveyor 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 (LRA) level. Before troubleshooting, review the procedures, figures, and tables in this book. Also, read the System Overview to understand how the Ocean Surveyor processes data.

Under all circumstances, follow the safety rules listed in Troubleshooting Safety.

Do NOT ping the Ocean Surveyor/Observer with the transducer in air. The power assembly board will short, causing the electronics chassis to no longer communicate. The transducer is pinged by sending a CS or PT5 command or if *VmDas* is started for collecting data – either of these methods will cause damage if the transducer is in air.

The provided information assumes that faults are isolated with a large degree of certainty to a LRA level only. Considering the complexity of the Ocean Surveyor, it is Teledyne RD Instrument's intention to provide as much information as practical for field repair; fault location to the component level is beyond the scope of these instructions. The mean 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, Teledyne RD Instruments strongly advises the availability of the listed LRAs.

Table 19: List of Least Replaceable Assemblies

LRA	Description:
Electronics Chassis	The Electronics Chassis contains all electronics necessary to supply power, provide user communication and interface, transmit and receive signals, interfaces to sensors, and process data.
Transducer Cable	Connects the transducer with the Electronics Chassis.
Transducer	The entire transducer: includes the transducer electronics, transducer housing, transducer ceramic assemblies, and connector.

Since these LRAs are manufactured in different configurations, please contact Teledyne RD Instruments (see How to Contact Teledyne RD Instruments for contact information) to obtain the correct part number for your specific system configuration. Please provide the serial numbers of the Transducer and Electronics Unit when contacting Teledyne RD Instruments about a replacement assembly. If you want to replace the Transducer Cable only, then please provide the cable length and connector style (straight or angled) for both the Underwater Transducer Connector and the Dry-side Electronics Chassis Connector.

Equipment Required

Special test equipment is not needed for trouble shooting and fault isolation. The required equipment is listed in Table 20. Any equipment satisfying the critical specification listed may be used.

Table 20: 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.

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

Basic Steps in Troubleshooting

The first step in troubleshooting is determining what type of failure has occurred. In principal, there are four types of failure classes:

- Communication failure
- Built-In Test (BIT) or other electronics failure
- Beam failure
- Sensor failure

Communication failures involve the host computer, the Ocean Surveyor Electronics Chassis, and the serial communication cable. The symptoms may include that the system is not responding, or does not respond in a proper fashion (for example “garbled” text).

BIT failures will appear when the system diagnostics are run. Use Teledyne RD Instruments software utility *TRDI Toolz* to identify the failing test.

Beam failures can be identified when collecting data or when the system diagnostics are run.

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

Troubleshooting Safety

Follow all safety rules while troubleshooting:

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

Shock Hazard!

Always treat the array as if it is charged. The array may hold a residual charge created by even minor temperature or pressure changes.

Do not come in contact with any traces on the beamformer board while the P1, P2, P3, and P4 row and column cables are connected.

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

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. 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.

Complete the ground path. The power cord and the outlet used must have functional grounds. Before main power is supplied to the Ocean Surveyor, the protective earth terminal of the instrument must be connected to the protective conductor of the mains power cord. The mains plug shall 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.

If this instrument is supplied via an auto-transformer, make sure the common terminal is connected to the earth terminal of the power source.

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.

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.

Do not operate the Ocean Surveyor Electronics Chassis in the presence of flammable gasses or fumes. Operation of any electrical instrument in such an environment constitutes a definite safety hazard.

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

Do not attempt to open or service the power supply.

Troubleshooting a Communication Failure

Ocean Surveyor ADCPs communicate by means of two serial communication channels. The user can choose between RS-232 and RS-422 types of asynchronous serial interfaces by connecting to either J4 (RS-232) or J3 (RS-422) on the rear panel of the Electronics Chassis.

The Ocean Surveyor selects the user communications port simply by detecting on which channel it received its *Break* signal. From this point on forward, it uses that channel until it receives a new *Break* signal on the other channel.

To successfully communicate, both the host computer and the Ocean Surveyor must communicate using the same type of serial interface. Standard serial interfaces in IBM compatible computers are also RS-232. RS-422 communication requires an appropriate communications board for the host computer.

> If you are using a high baud rate and a long serial cable (greater than 15 meters) RS-232 may not work properly. Change to RS-422 and try to wake up the Ocean Surveyor again.

Communication Failure Quick Checks

If you cannot communicate with the Ocean Surveyor/Observer (i.e., no wakeup message), you need to isolate the problem to a computer fault, power, communication cable failure, or an Electronic Chassis problem. Verify the following:

1. Connect the Ocean Surveyor to a computer as shown in Figure 5. Check that all cable connections are tight.
2. Make sure that Mains power to the host computer and the Ocean Surveyor is connected and has the proper voltage. Verify that the Ocean Surveyor front panel circuit breaker switch is in the ON position and that the power status LED next to the circuit breaker is lit. If power is present but the power status LED is not lit then you should check the power supply voltages inside the Electronic Chassis (see Checking the Power Supply).
3. Make sure that your computer and the *TRDI Toolz* program are set up to use the communication port the serial cable is connected to on the electronic chassis.

> Most communication problems are associated with incorrect cable connections (i.e. the serial cable is connected to the wrong port) or data protocols (i.e. the wrong baud rate is set between the Ocean Surveyor and computer).

Checking the Serial Communications Channels

The following procedure checks the serial communications channels using an EIA Break-Out Box. If you do not have an EIA Break-Out Box, use Checking the Serial Cable to verify the communications. If you are using RS-422 serial communications, you can not use an EIA Break-Out Box. Use the RS-422 Communication checks to verify the communications.

1. If you are using RS-232 for your communications port, connect a serial data EIA Break-Out Box between the serial cable and the Ocean Surveyor Electronics Chassis.
2. Send a Break and verify via the LEDs on the Break-Out Box that the Break signal arrives at the proper pin at the Ocean Surveyor (see Figure 31). If it does, verify that the front panel LED marked RXD lights up temporarily.

   If the Break signal does not arrive at the proper pin or not at all, disconnect the serial cable from the Ocean Surveyor Electronics Chassis, and troubleshoot the communication channel between the host computer and that end of the serial communications cable.

If the Break signal does arrive at the proper pin but the front panel RXD LED does not light up then there may be a problem with the Ocean Surveyor Electronics Chassis (see Electronics Chassis Checks).

3. If the Break signal does arrive at the proper pin and the front panel LED labeled RXD lights up temporarily, this indicates the Break signal does arrive at the Ocean Surveyor Electronics Chassis.

   The Ocean Surveyor must now respond with a 'Wake-up" message. The front panel TXD LED should intermittently light up. If it does not, then there is most likely a problem with the Ocean Surveyor Electronics Chassis (see Electronics Chassis Checks).

   If the TXD LED does light up then the Break-out Panel should receive the signal at the proper pin. If this is the case, then the Ocean Surveyor Electronics Chassis' data path seems in principal to be operational. If the wakeup message is not readable, check for a communication mismatch (see Communication Mismatch).

RS-422 Communication

If you use the RS-422 port as your communications port, you can not use the Break-Out Box. Do the following checks to verify the RS-422 communication port is functioning.

1. In addition of having transmit and receive pairs interchanged, you may have also the "A" and "B" lines of the transmit and/or receive pair interchanged. Verify the communications cable connections according to the schematics provided (see Figure 31).
2. Check that the differential "A"-"B" receive pair are not interchanged (as seen from your host computer). Verify the communications cable connections according to the schematics provided (see Figure 31).

> For the Ocean Surveyor ADCP, Channel A represents signals that start high and transition low. Channel B represents signals that start low and transition high.

3. When you send a *Break* and the data is not the Wake-Up message, you may have a Baud rate or parity mismatch between the Ocean Surveyor and the computer (see Communication Mismatch).

Communication Mismatch

The following conditions may indicate a communications mismatch:

- Sending a *Break* causes non-alphanumeric characters to appear on the screen that may keep scrolling. This may happen when the computer is using RS-232 and the Electronics Chassis is connected to the RS-422 port or vice-versa.
- Sending a *Break* causes non-alphanumeric characters to appear on the screen. These characters do not keep scrolling. Check that the ADCP and computer are both using the same baud rate (CB-command).

Checking the Serial Cable

This test will check the serial communication cable between the computer and Ocean Surveyor *without* using an EIA Break-Out Box.

1. Disconnect both ends of the serial cable and measure the continuity using a DMM (see Figure 31 for the wiring diagram). Correct any problems found.
2. Reconnect the serial cable to host computer. Start the Teledyne RD Instruments software utility program *TRDI Toolz* on your computer. Make sure to select the proper communications port (see the RDI Tools User's Guide).

3. For testing a RS-232 cable, jumper pins 2 and 3 at the far end of the cable. To check a RS-422 cable, connect one jumper between pin 2 to 4, and one jumper between pins 7 to 8.
4. Type any characters on the keyboard. The keys you type should be echoed on the screen. If you see some characters, but not correctly, the cable may be too long for the baud rate. Try a lower baud rate. If this works disconnect the jumper and then push any keys on the keyboard. You should NOT see anything you type.
5. If you use cables that are **not** supplied by Teledyne RD Instruments you must make sure that transmit and receive pairs are not interchanged. 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 Figure 31.

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

6. If the keys are echoed correctly on the screen, the computer and the communication cable are most likely good. Re-connect the serial cable to the Ocean Surveyor electronic chassis. If the Ocean Surveyor still does not wakeup, there could still be a problem with the Electronic Chassis.

Electronics Chassis Checks

Once you have eliminated possible problems with the Ocean Surveyor system power, the serial data communication cable, and the host computer, that may leave the Ocean Surveyor Electronics Chassis as the source of the problem. Check the following conditions:

The Ocean Surveyor contains Electro Static Sensitive Devices. You must take accepted ESD prevention measures before opening the Ocean Surveyor electronics chassis.

1. One of the interconnecting cables between the Motherboard inside the Electronic Chassis may not be fully seated. Turn off power. Remove the top cover of the Electronic Chassis and check that all of the cables are properly seated.
2. Make sure power to the Ocean Surveyor is connected and that the circuit breaker is in the ON position. Verify that the power status LED indicator located at the front panel next to the circuit breaker switch is lit. If the LED is not on, skip to Checking the Power Supply.
3. Reset the system by locating the push button switch S2 on the Motherboard and momentarily depress the switch. Observe the TXD LED for lighting up, and the computer screen for displaying the Wake-Up message.
4. Switch Mains power to the Electronics Chassis off, and after a few seconds on again. Repeat the wakeup procedure from the beginning. If the system does not respond normally, it is malfunctioning and you should contact Teledyne RD Instruments.

Checking the Power Supply

The following test is done with a voltmeter to verify the voltage levels inside the Electronic Chassis.

Use the test points on the Power Assembly board located in the top right corner of the Electronic Chassis. Use Table 21 to verify the system voltages. If the voltage at test point TP3 is not present, check and replace fuse F1 if necessary. Observe all safety precautions.

If after replacing the fuse F1 the voltages listed in Table 21 are still not present with applied mains power or fuse F1 blows again, it may be necessary to replace the Ocean Surveyor Electronics Chassis.

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 fire hazard. Disconnect the power cord before attempting to replace fuse F1.

Table 21: Electronic Chassis Voltage Checks

Test Point	Value	Description
TP0	0 VDC	GND, ground reference
TP1	4.95 ≤ Vdc ≤ 5.05	VCC, Electronics power
TP2	11.5 ≤ Vdc 12.5	VXDC, Transducer power
TP3	47 ≤ Vdc ≤ 49	VXMT, Transmitter supply
TP4	9.0 ≤ Vdc 11.5	VGG, Transmitter gate drive supply

The voltage measured at test point TP3 is also the output voltage from the Electronic Chassis power supply.

Example Problem - The Electronic Chassis does not Power up

When the power switch is turned on, no LEDs light up. The fuse F1 is good. Measuring the voltage at TP3 indicates that the electronic chassis power supply is bad. However, this could be misleading because the Power Assembly board may have shorted out and this is causing the power supply to shut down.

If the power supply fan is running, then most likely the power supply is OK and a shorted Power Assembly board is causing the problem.

Replacing the Power Assembly board or Power Supply in the field is not recommended. Return the chassis to TRDI for repair.

Pinging the transducer in air is the leading cause of shorting the Power Assembly board. Never ping the transducer in air.

Troubleshooting a Built-In Test Failure

The built-in diagnostic tests (BIT) check the major ADCP modules and signal paths for reasonableness. If any BIT test is outside what would normally be considered reasonable (see Testing the Ocean Surveyor/Observer), than check the following items:

- Turn off all other acoustic devices.
- Ensure that all monitors are at least 1 meter (3 feet) from the electronic chassis.
- The vessel is stopped.
- The vessel is in at least 3 meters of water below the transducer.
- No air is in front of the transducer.

Failure Scenario: PT3 Test Fails

The PT3 test is intended to confirm the presence of externally and internally generated interference terms. This test does not send any transmit pulse. This test only checks the receive path circuitry for the energy from signals. If there is energy then a failure condition will occur in this test. This test may also fail if there is a problem with the receive circuitry from the transducer assembly to the electronics chassis. Therefore, if a failure of the PT3 test occurs there are several additional tests that should be run to confirm whether this is an interference problem or if it is a hardware failure.

This test is designed to run with the transducer connected while it is in water. However, the test can also be run in air, with the transducer connected, or with the transducer disconnected. Running these tests in these different configurations does not cause the test to fail. This is because we are only looking for an interference term not the connectivity of all components. Therefore, you should know that a pass condition is possible in all of the following setups:

- The transducer is in water and connected to the electronics chassis through the cable.
- The transducer is in air and connected to the electronics chassis through the cable.
- The transducer cable only is connected to the electronics chassis.
- The electronics chassis has no transducer or transducer cable attached to it.

While it may seem odd that a pass condition is possible in all of the above setup conditions you must remember that this test is intended to only check for the possibility of interference. If there is no interference present then the test SHOULD pass in all of the above setups.

The 150kHz transducer is particularly susceptible to self-interference when the transducer is disconnected. PT3 may (or may not) fail in this condition. It is most important that PT3 passes with the transducer connected and in water. If it passes with it connected, but fails with it disconnected - don't worry about it.

Now, if this test does fail, then by testing the system in each of the above configurations you will be able to determine where the interference is coming into the system or where a hardware failure exists.

Possible failures: As stated the problem could be caused by either an externally generated interference term or as a problem in the hardware (electronics chassis, cable, or transducer).

Trouble-Shooting Process: You must first isolate the possibilities since a PT3 failure could be externally generated or by an internal failure. Use the following steps in the order shown to be able to perform this isolation:

1. To check for an externally generated cause, you must turn off power to all other sensors and all non-required equipment and computers.
2. Run the PT3 test. If the test fails continue to step 3. If the test passes then you have an externally generated signal and you need to discover which item is causing the interference. This can be done by incrementally turning on each piece of equipment and running the PT3 test until you find the offending device. If you cannot find any cause of the interference then skip to step 9.
3. Turn off power to the ADCP.
4. Remove the transducer cable from the back of the electronics chassis.
5. Turn on power to the ADCP.
6. Run the PT3 test. If the test passes then skip to step 7.

   If the test fails then remove the chassis from the area you are testing and to a completely new location with a different AC power source. Run the PT3 test again. If the test still fails then the chassis has a problem and you need to return the electronics chassis to TRDI for repair. If the test passes continue to step 7.
7. Connect the transducer cable to the back of the electronics chassis and disconnect the transducer cable from the transducer.
8. Run the PT3 test. If the test passes then skip to step 9.

   If the test fails then this suggests that the cable is the problem. The cable may have a problem in the wiring. You must run the end-to-end test shown in Table 22. If the test passes then continue with step 9 to confirm if the problem is externally generated or not.
9. At this point, the problem has been either isolated to the transducer or you have an externally generated interference term. To determine if this PT3 failure is a problem you should collect single ping beam data for at least one hour and send it to TRDI for further review.

   We provide the following information for general outlines of how the data can be inspected to determine if there is really a problem in the system.

   a. You must review the data for reasonable echo intensity values and that it is free of spikes. Reasonable values will have the beginning of the profile start between 130-200 counts. At the end of the profile the echo intensity values should be between 10-50 counts. You will then want to review the echo data as a color contour plot (in *WinADCP*) to look for any spikes (high echo intensity values relative to the depth cells around it) that show a repeating pattern (see Figure 23). If there is a repeating pattern then you have external interference. Continue with step 9b to determine if you have bias from this interference.

   b. You must review the correlation data for signs of reduced correlation (less than 160 counts) in first 50% of the profile. You also need to review the area where you found echo intensity spikes for reduced (relative to the surrounding depth cells) correlation values. If the correlation is noticeably reduced you must contact TRDI for further review of the data.

   c. You must review the vertical and error velocities for reasonableness. You will want to inspect them for unreasonable spikes (consistent spikes at the same depth cell on every ensemble, or spikes that match up with the echo intensity spikes), see Figure 24. If there are spikes then the interference is biasing your data. You must either find or disable the external system that is interfering or you must return the ADCP to TRDI for repair.

Failure Scenario: PT6 Test Fails

The PT6 test is intended to confirm the proper impedance matching between the electronics chassis, the cable, and the transducer. This test does not send any transmit pulse. This test only checks the receive path circuitry for proper impedance matching. If the PT3 test fails then it is probable that this test will fail also. Therefore you should first troubleshoot the PT3 test failure and then check for the causes of the PT6 fail.

This test is designed to run with the transducer connected and in water. It can be run in air, with the transducer connected, or with the transducer disconnected. Running these tests in these different configurations does not cause the test to fail. This is because we are only looking for a proper impedance matching and not the connectivity of all components. Therefore, you should know that a pass condition is possible in all of the following setups:

- The transducer is in water and connected to the electronics chassis through the cable.
- The transducer is in air and connected to the electronics chassis through the cable.
- The transducer cable only is connected to the electronics chassis.
- The electronics chassis has no transducer or transducer cable attached to it.

If this test does fail then by testing the system in the above configurations will allow you to determine where the interference is coming into the system or where a hardware failure may exist.

> The 150kHz transducer is particularly susceptible to self-interference when the transducer is disconnected. PT3 and PT6 may (or may not) fail in this condition. It is most important that PT3 and PT6 pass with the transducer connected and in water. If it passes with it connected, but fails with it disconnected - don't worry about it.

Possible failures: This problem could be caused by an external interference term or as a problem in the hardware (electronics chassis, cable, or transducer).

Trouble-Shooting Process: Since a PT6 failure could be caused by an externally generated interference term, you must first check the PT3 test for failures. If PT3 passes or you have run the PT3 checks then use the following steps to determine the cause of the PT6 failure.

1. Turn off power to the ADCP.
2. Remove the transducer cable from the back of the electronics chassis.
3. Turn on power to the ADCP.
4. Run the PT6 test. If the test passes then skip to step 5. If the test fails then there is a problem with the chassis and it must be returned to TRDI for repair.
5. Turn off power to the ADCP.
6. Connect the transducer cable to the back of the electronics chassis and disconnect the transducer cable from the transducer.
7. Run the PT6 test. If the test passes then skip to step 8. If the test fails then the problem is in the cable and you need to perform the cable resistance checks in Table 22.
8. If all of the previous tests have passed then you have confirmed the problem is in the transducer and you need to contact TRDI for return and repair of the transducer.

Troubleshooting a Beam Failure

Failure Scenario: One or more beams are showing near zero and flat returns on echo intensity.

Background: The echo intensity values represent the relative signal strength along each beam at each of the depth cells. The echo intensity values normally start between 130-180 counts and will end (assuming you are collecting data to the end of the profiling range) at 10-40 counts.

If a beam is not returning signals, then it will not be collecting data. The result is that if only one beam is showing low echo returns then the ADCP will perform three beam solutions. If more than two beams are showing low echo returns then the ADCP will not be able to collect any data.

Possible failures: (Refer to Figure 25 through Figure 27)

- Typically, if the echo intensity data is indicating low returns so will the correlation data. If the correlation data looks acceptable while the echo intensity is low, then this indicates a problem on the receive side only and not on the transmit side. This could be a problem within the transducer wiring, the transducer Beam Former board, the transducer to electronics chassis cable, or the electronics chassis.
- If the echo intensity and the correlation data is indicating low returns on all four beams then this is most likely a problem with the transmit circuitry or the transducer Beam Former board.

Trouble-Shooting Process:

1. Run the PT tests and check for failures. If there are failures then use the troubleshooting listed for these failures to isolate the likely components.
2. If there are no PT failures associated with this failure, then you must unplug the transducer cable from the back of the electronics chassis and collect data with the same setup you were using. All four beams should produce no echo intensity or correlation returns. If the results of the four beams do not look the same then it is likely that there is a problem in the electronics chassis.

> Once the transducer cable is disconnected, it is safe to ping the Ocean Surveyor/Observer in air.

3. If no change in the results occurred during step 2 then you must run the resistance checks (see Checking the Transducer I/O Cable). Disconnect the transducer cable from the back of the electronics chassis. Using a meter confirm that the resistances in Table 24: Transducer Dry Connector Resistance Check are valid. If they PASS then proceed to step 5. If they FAIL then proceed to step 4.
4. Gain access to the Transducer bulkhead connector and remove the cable from the connector. Using a meter confirm that the resistances in Table 23: Transducer Wet Connector Wiring Resistance Check are valid. If they FAIL then the transducer has failed and must be returned to TRDI.
5. If step 3 and/or step 4 PASS then you are unable to confirm which part has actually failed and you must return the entire ADCP to TRDI.

Troubleshooting Data Problems

Failure Scenario: Range is limited and the echo intensity values at the end of the profile are higher than 50 counts.

The echo intensity values represent the relative signal strength along each beam at each of the depth cells. The echo intensity values normally start between 130-180 counts and will end (assuming you are collecting data to the end of the profiling range) at 10-40 counts.

If the echo intensity values at the end of range are greater than 40 counts, then the background noise is much higher than expected. This raised background noise will reduce the signal to noise ratio and result in a loss in range.

Each echo intensity value has a rough value of 0.5 dB. For every two counts of increase in the background noise there is a 1dB increase in noise. A generally excepted rule of thumb is that for every dB of increase in the background noise at the end of profiling range there will be a loss of one default depth cell in range (150kHz = 8meters, 75kHz=16meters, and 38kHz=32meters).

Possible failures: (Refer to Figure 25 through Figure 28)

- The background noise is typically the result of externally generated signals, such as the operation of thrusters on an oil platform, the prop on a vessel, or the flow of water across the transducer when traveling at speed on a vessel.
- It is also possible for other sonar devices to increase the background noise floor.
- And finally, a failure in the electronics chassis, cable, or beam former can cause an increase in the Background noise.

Trouble-Shooting Process: Run all PT tests. If there are any failures, follow the troubleshooting section to locate the fault. If there are no faults then go to step 2.

1. Since the common causes of this issue is related to external generated noise, it is recommended that you unplug power to the electronics chassis and remove the transducer cable. You should operate the system just as you had. The echo intensity values you should get in this setup should be consistently <40 counts for the entire profile on all four beams. If it is elevated then the electronics chassis has failed and needs to be repaired. If it passes then go to step 2.
2. At this point the raised noise floor is most likely not in the ADCP, but the only way to confirm this would be to either to have the thrusters turned off, the vessel slowed down, or to turn off all other equipment to confirm. As this may not be possible, the only thing to do would be to check the resistances (see Checking the Transducer I/O Cable) to confirm that there is no other possible failure.

   If these tests PASS then the problem is most likely generated from external signals and there is no solution other than to lower the ADCP farther away from the thrusters or to place a window in front of the transducer. If these have been tried without success then send a set of single ping beam data to the TRDI Field Service department for them to inspect the results and to provide you with the best course of action to take.

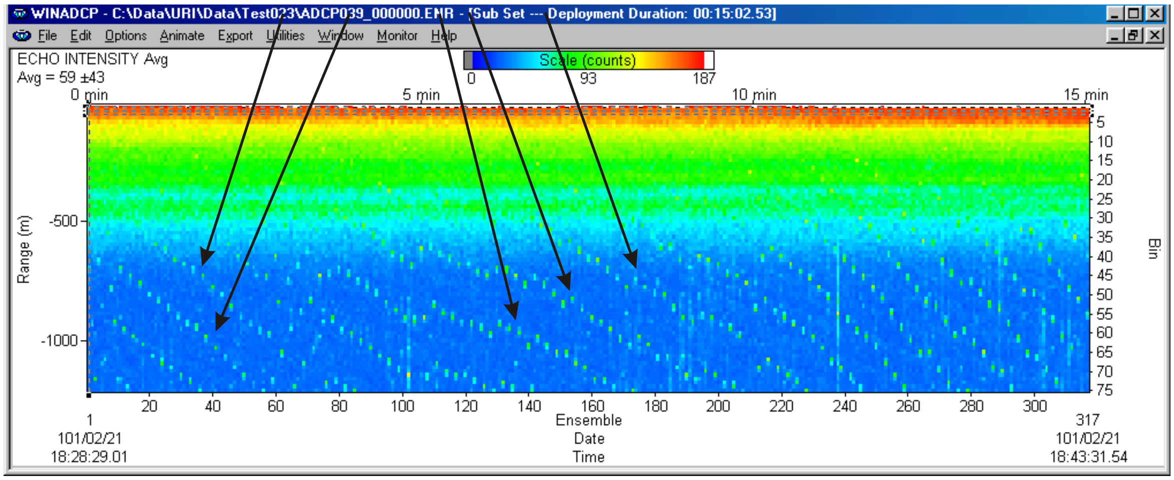


Figure 23. Repeating Pattern of Interference Terms in the Echo Intensity Contour Plot

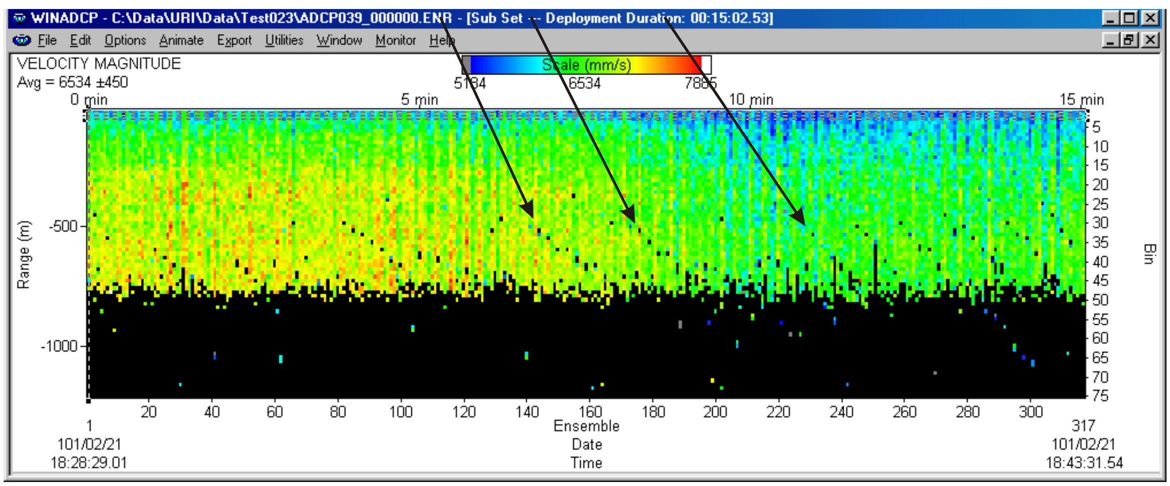


Figure 24. Repeating Pattern of Interference Terms in the Horizontal Magnitude

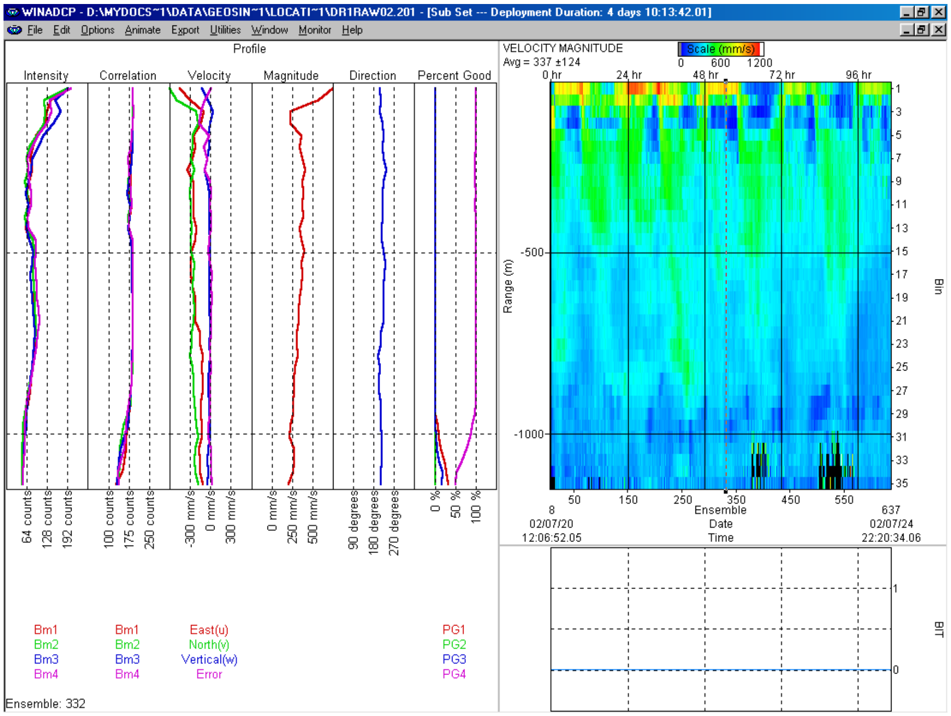


Figure 25. Expected Output Levels for Ocean Observer in NB Mode

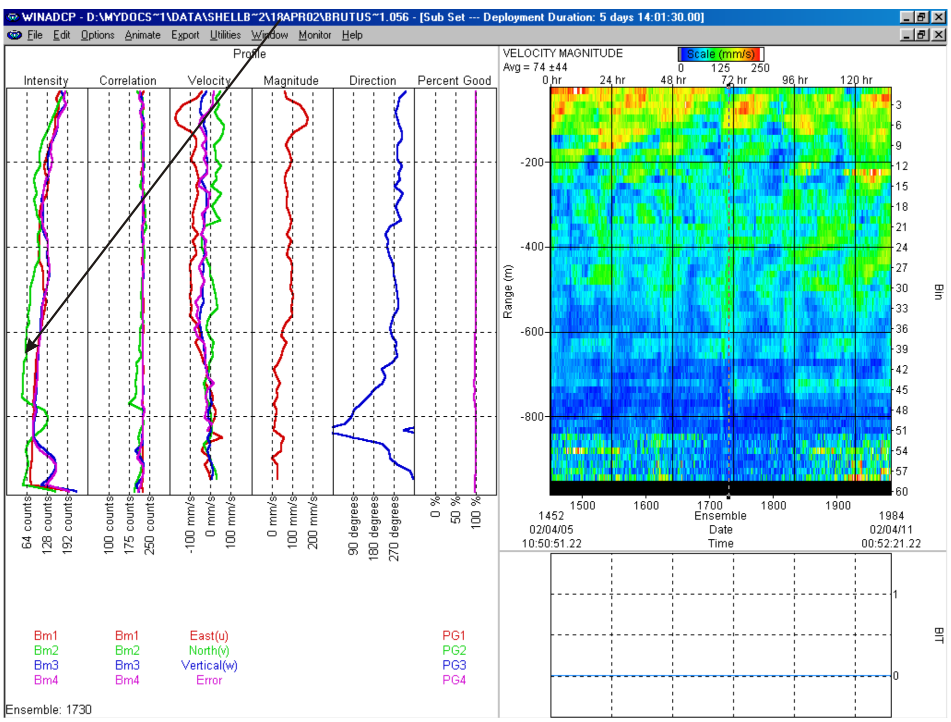


Figure 26. Weak Returns on a Single Beam (Beam 2) for Ocean Observer in BB Mode

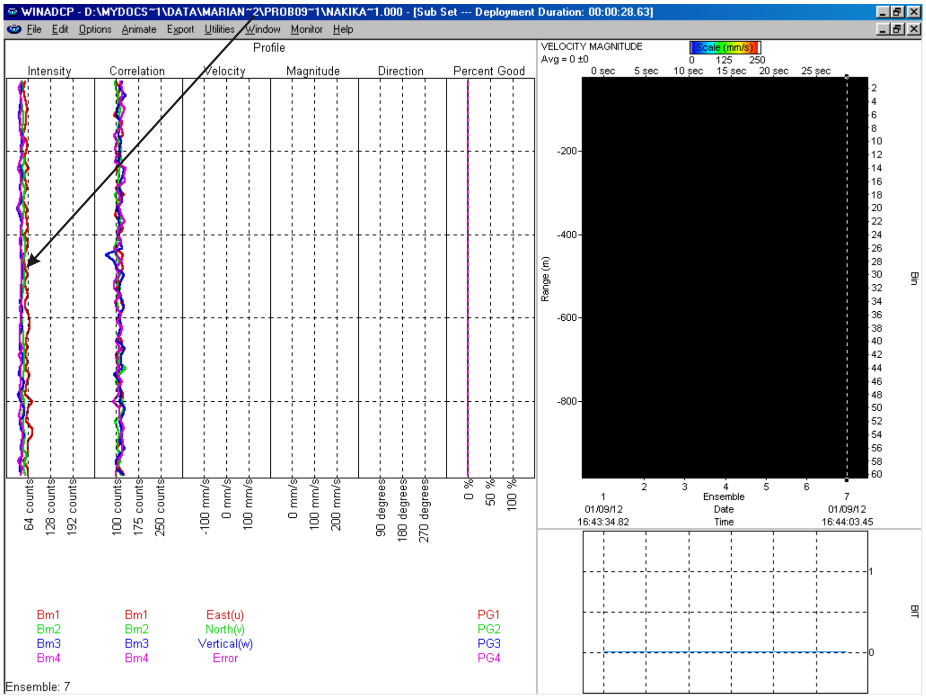


Figure 27. Weak Returns on all Four Beams for Ocean Observer in BB Mode

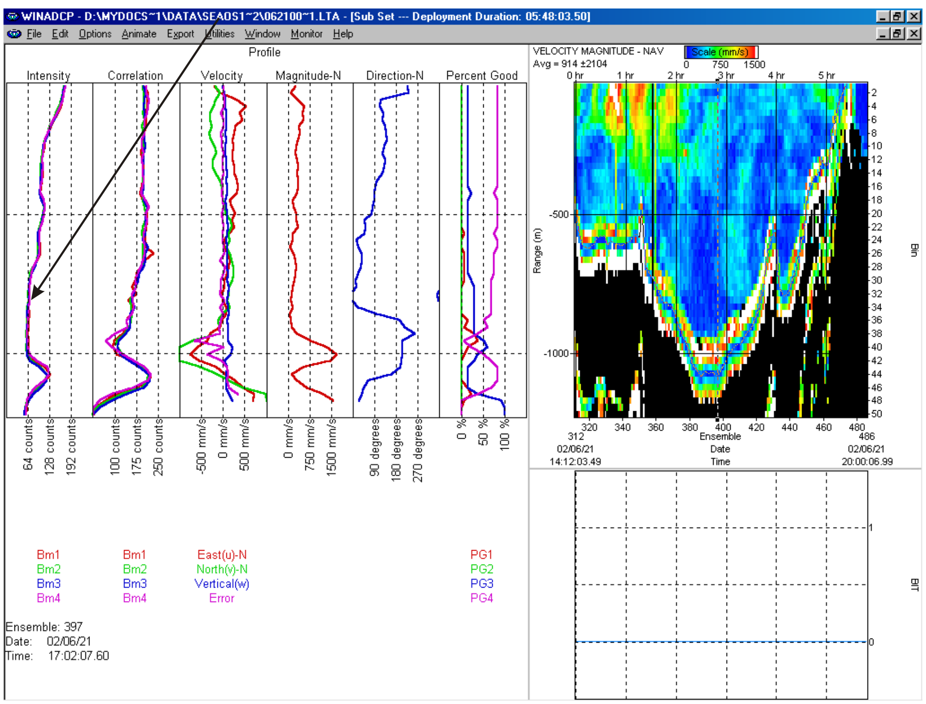


Figure 28. Range Limited at the Noise Floor for Ocean Surveyor in BB Mode

Troubleshooting a Sensor Failure

Run the PC2 test to isolate the problem. The temperature sensor is imbedded in the transducer head, and is used for water temperature reading. The displayed Heading, Pitch, and Roll sensor data source is set according to the selection via the EZ command.

An open temperature sensor connection would approximately indicate the counts and degrees as given in the example below. A shorted temperature sensor or connection would indicate approximately 92 °C.

```
>PC2
Heading      Pitch      Roll       Temperature
 (int)       (int)      (int)      cts     degs
 000.0       +00.0      +00.0      0FF6    -36.3
 000.0       +00.0      +00.0      0FF5    -36.2
>
```

If the temperature sensor is bad, the data can still be collected without effecting the accuracy or quality. Contact TRDI about scheduling the repair of the temperature sensor at your convenience.

For External Sensor verification, see Testing the Ocean Surveyor/Observer and the Installation Guide.

Fault Log:

To determine why a sensor failed, view the fault log. To view the fault log, start *TRDI Toolz*. Press the **End** key to wake up the ADCP. Send the following commands: **CR1**, **PC2**, **LD**. The LD-command displays the fault log.

```
[BREAK Wakeup A]

Ocean Surveyor Broadband/Narrowband ADCP
TELEDYNE RD INSTRUMENTS (c) 1997-2000
ALL RIGHTS RESERVED
Firmware Version 23.xx
>
>CR1
>PC2
|         (PC2 test results (not shown))
|
>LD
Time of first fault:    2000/08/23,10:08:13
Overflow count:                  0

Fault Log:
     Code              Count            Time                    Parameter
506  TEMP RANGE           3       2000/08/23,10:08:22       FFFFF1D7h
203     RTC CAL           2       2000/08/23,10:08:19       00000001h

End of fault log.

>
```

The LL command displays a list of different faults that can be recorded in the fault log.

Troubleshooting the TCM2 Compass

Failure Scenario: TCM2 Compass Not Detected – an error message is displayed.

The Ocean Observer is intended for installations on oil platforms. The configuration of the Ocean Observer transducer includes an internal TCM2 compass as part of its factory build. The compass is used to provide heading, pitch, and roll information. This compass is a flux gate compass and therefore is biased by magnetic fields. As a result, the TCM2 compass is *not* included in the Ocean Surveyor (which is intended for vessel mount installations).

To utilize this compass the electronics chassis must first be configured to detect the TCM2 compass whenever a break signal is sent to the electronics chassis. The electronics chassis is configured to detect TCM2 compass at the factory, but it can be changed in the field.

Power is supplied to the compass from the electronics chassis. Communications between the TCM2 compass and the electronic chassis is done through an RS232 link at 38400-baud, no parity, and 8 data bits. The TCM2 compass is read at the start of each ping and the readings of the heading, pitch, and roll data are stored in the ADCP variable leader data.

Possible failures:

- The system is configured incorrectly and is trying to detect the TCM2 compass when it should not.
- The transducer cable to electronics chassis is not connected, or has a broken or shorted wire.
- The cable inside the transducer assembly between the end cap and the TCM2 compass is not connected, or has a broken or shorted wire.
- The TCM2 compass power and/or communications circuitry in the electronics chassis Motherboard has failed.
- The TCM2 compass has failed inside the transducer.

Trouble-Shooting Process:

1. If you have an Ocean Observer skip to step b. If you have an Ocean Surveyor and you are receiving this error message, then the chassis has not been configured properly and you need to do the following:
    a. Type @C – The ADCP will respond with a configuration list. You will want to ensure that both the TCM2 Detect is DISABLED and that the Platform is set to SHIP. If they are not set properly then follow steps b through e to set them properly.
    b. Type D to access the TCM2 configuration.
    c. Type 0 to disable the TCM2 compass.
    d. Type P to access the Platform configuration.
    e. Type 0 for Ship configuration.
    f. Type 1 to Save and Exit.
    g. After the wake up message appears the system has been configured properly.

```
>@C
WARNING:  Changing system configuration may affect performance!
          Know and understand the consequences before changing
          any settings.

System Configuration Menu

     0    Exit without Saving
     1    Save and Exit
     B    Beam Former Rev      A02 or later
     D    TCM/2 Detect         DISABLED
     O    Test Port            DISABLED
```

```
     P    Platform            SHIP
     S    Synchro Detect      ENABLED
     X    Transducer Type     ROUND 36x36
     ?    Display Menu
% 1

System Config saved to FLASH
```

2. There are four connections to the TCM2 board that are required for the TCM2 compass to work properly. These are power, ground, RS232 in, and RS232 out. A bent pin or poor connection at the back of the chassis can cause one or more of these connections to be bad. Confirm that the transducer cable connector is seated properly at the electronics chassis.

   If the connector cable is seated properly, then you will need to confirm that the connections through the cable (from the electronics chassis to the transducer) are good. The first check will be to determine if the resistances measured at the dry end cable connector are good. If they are not good, then you will have to check the resistances at the transducer bulkhead connector. If they are good there then the problem is in the cable and now you need to check the resistance from end to end on the transducer cable. Use these steps to perform these checks.

   a. Disconnect the transducer cable from the back of the electronics chassis. Using a meter to measure resistance confirm that the resistances in Table 24: Transducer Dry Connector Resistance Check are valid. If they PASS then proceed to step 3, if not then continue to step 2b.

   b. Gain access to the Transducer bulkhead connector and remove the cable from the connector. Using a meter to measure resistance confirm that the resistances in Table 23:Transducer Wet Connector Wiring Resistance Check are valid. If they PASS then proceed to step 2c.

   c. If step 2a and step 2b pass then you should go to step 3. If step 2a failed, but step 2b passed then the fault is in the transducer to electronics chassis cable. To confirm the fault in the cable perform the checks in Table 22: I/O Cable End to End Cable Resistance Check. If the cable checks out good then the redo the tests in step 2a.

3. At this point we have confirmed that all of the connections from the back of the electronics chassis to the TCM2 board inside the transducer are good. This leaves us with either a hardware fault in the electronics chassis or on the TCM2 board itself.

   If the electronics chassis circuitry is found to be functioning properly then the TCM2 board inside the transducer has failed and needs to be repaired or replaced. See the Maintenance chapter on how to gain access to the TCM2 board.

   If the electronic chassis circuitry is found to be non-functional then the electronics chassis must be repaired at the TRDI factory.

   In the meantime, it will be necessary to test the TCM2 board again after the electronics chassis has been repaired or to return it with the electronics chassis for inspection and repair.

   The following steps will confirm if the electronics chassis is working properly.

   a. Turn off power to the electronics chassis.

   b. Remove the electronics to transducer cable from the back of the electronics chassis.

   c. We want to make sure that there is power available to the TCM2 board. Place the leads from a DC voltmeter between pins U (VDC +) and T (VDC -) on the connector J1 on the back of the electronics chassis.

   d. Turn on power to the electronics chassis. You should measure between 11.5 – 12.5VDC. If this is correct, then go to step 3e. If this voltage is not correct, then the electronics chassis must be returned to Teledyne RD Instruments for repair.

   e. Turn off power to the electronics chassis.

f. We now want to confirm that the TCM2 RS232 circuitry in the electronics chassis is working properly. You will want to use a wire (a paper clip works well) to short pins k and m off J1 connector on the back of the chassis.

g. Connect the electronics chassis serial connector to the computer.

h. Start up the TRDI *TRDI Toolz* program. Configure the program for communications to the electronics chassis.

i. Turn on power to the electronics chassis. The wake up message should appear on the screen.

j. Type the command &M9. The TCM2 terminal mode is now active.

k. Type any letter or number character on your keyboard. The keys you type should be echoed on the screen. If the keys are echoed then the RS232 TCM2 circuitry is working properly and the TCM2 board requires repair. If the keys are not echoed then the electronics chassis must be returned to TRDI for repair.

If you have determined that the electronics chassis is not working then you may have still have a bad TCM2 board. Currently, there is no way to confirm if the TCM2 board is functioning properly without the chassis. TRDI will be creating a special testing fixture that will allow you to test the TCM2 board at the transducer connector and at the TCM2 board itself to check for proper operation.

Troubleshooting Software Problems

The computer requirements change depending of the number of COM port, baud rate, and refresh rate is used (see the Installation Guide for computer requirements). The symptoms that the computer is struggling to process the data are:

- The computer shows the message “lost ensemble” when you use the keyboard.
- The computer shows the message “lost ensemble” when you change the display from *VmDas* to *WinADCP*.
- Repetitive errors are found in the .log file

Example

```
[2001/07/24, 10:47:12.385]: NMEA [RPH] serial buffer level OK.
[2001/07/24, 10:47:36.259]: NMEA [RPH] serial buffer full: Storing 300 bytes without processing.
[2001/07/24, 10:47:36.259]: NMEA [RPH] serial buffer level OK.
[2001/07/24, 10:47:40.275]: NMEA [RPH] serial buffer full: Storing 300 bytes without processing.
[2001/07/24, 10:47:40.275]: NMEA [RPH] serial buffer level OK.
[2001/07/24, 10:47:43.289]: NMEA [RPH] serial buffer full: Storing 300 bytes without processing.
[2001/07/24, 10:47:43.289]: NMEA [RPH] serial buffer level OK.
```

To correct “lost ensemble” problems it may be necessary to upgrade the computer you are using. We recommend the following:

- A good quality video card is required to operate *VmDas* and *WinADCP* simultaneously. We do not use graphic card 3D functions; however, video memory is needed to display all graphics.
- 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 display and keyboard without losing ensembles.

Ocean Surveyor Cables

This section provides information on Ocean Surveyor 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 trouble-shooting the ADCP. If you feel there is a conflict, contact TRDI for specific information about your system. Where shown, the color code is for reference only; your cable may be different. The following figures show various Ocean Surveyor cable connectors and pin-outs (see I/O Cable Overview for cable specifications).

Checking the Transducer I/O Cable

For checking the Transducer cable, it is recommended that both ends of the cable are disconnected and accessible. You must take care not to bend or otherwise damage any pins or sockets. Do not allow debris or moisture to enter the contact or O-ring surfaces of the connectors. While performing the continuity check, it provides the opportunity to verify the integrity of the O-ring on the under-water mating connectors (see Replacing the I/O Cable O-Rings).

Use the schematic diagram Figure 29 and Table 22 to check the continuity of the transducer cable. Verify the pin-to-pin connections as indicated in the schematic; each connection should have continuity, where the resistance should nominally be 0.033 Ohms per meter of cable length at 20 °C (i.e., a 30 meter cable has a nominal conductor resistance of 1 Ohm at 20 °C). The isolation resistance between conductors, and conductors and shields should be at least 20 MOhm at 100 VDC. Note that if moisture is present you may not be able to obtain this isolation resistance.

Table 22: I/O Cable End to End Cable Resistance Check

Description	Cable Wet Connector	Cable Dry Connector	Resistance	Your Readings
Beam 1 XMIT	1	A	<200 ohms	
Beam 1 XMIT Return	2	W	<200 ohms	
Beam 1 XMIT Shield	N/C	V	N/A	
Beam 2 XMIT	3	D	<200 ohms	
Beam 2 XMIT Return	4	C	<200 ohms	
Beam 2 XMIT Shield	N/C	B	N/A	
Beam 3 XMIT	5	G	<200 ohms	
Beam 3 XMIT Return	6	F	<200 ohms	
Beam 3 XMIT Shield	N/C	E	N/A	
Beam 4 XMIT	7	K	<200 ohms	
Beam 4 XMIT Return	8	J	<200 ohms	
Beam 4 XMIT Shield	N/C	H	N/A	
Beam 1 RCV Hi	9	e	<200 ohms	
Beam 1 RCV Low	10	M	<200 ohms	
Beam 1 RCV Shield	21	d	<200 ohms	
Beam 2 RCV Hi	11	f	<200 ohms	
Beam 2 RCV Low	12	N	<200 ohms	
Beam 2 RCV Shield	21	q	<200 ohms	
Beam 3 RCV Hi	13	g	<200 ohms	

Description	Cable Wet Connector	Cable Dry Connector	Resistance	Your Readings
Beam 3 RCV Low	14	P	<200 ohms	
Beam 3 RCV Shield	23	r	<200 ohms	
Beam 4 RCV Hi	15	h	<200 ohms	
Beam 4 RCV Low	16	R	<200 ohms	
Beam 4 RCV Shield	23	s	<200 ohms	
TCM/2 VDC +12VDC	24	U	<200 ohms	
TCM/2 VDC GND	17	T	<200 ohms	
TCM/2 RS232 IN	18	k	<200 ohms	
TCM/2 RS232 OUT	19	m	<200 ohms	
RCV Enable	26	S	<200 ohms	
Temperature	25	i	<200 ohms	
Temperature RTN.	20	j	<200 ohms	
Overall Shield	22	L	<200 ohms	

If the TCM/2 voltages are not present then only the compass will stop working. The system will still be able to collect profile data.

If any one of the transmit wires are not correct then the system will NOT function correctly and MUST be repaired before accurate current data can be collected.

If one of the receive wires are not correct then depending on the failure the system may still be able to function properly with 3 beam solutions.

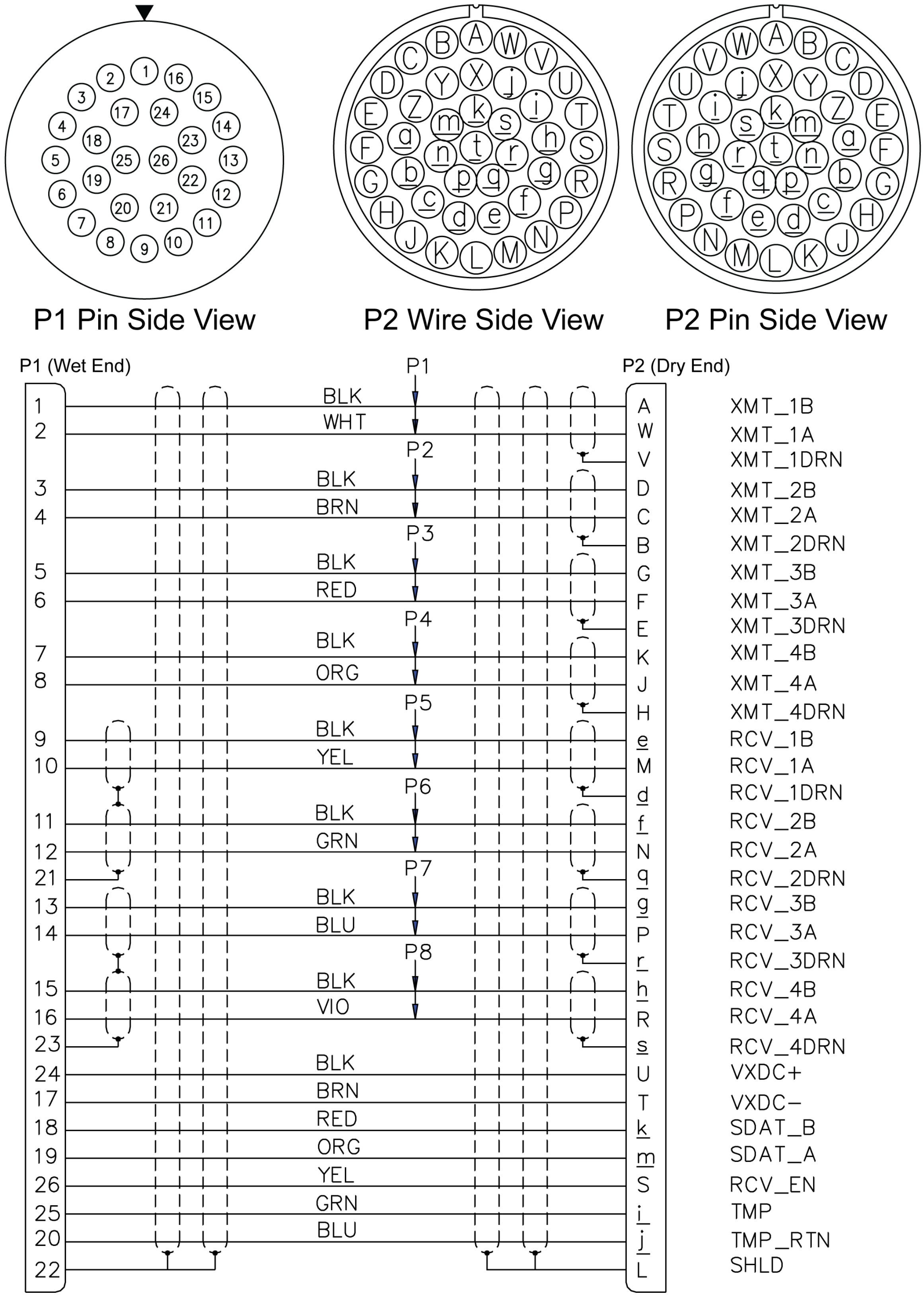


Figure 29. External I/O Cable Wiring (Drawing Number 73A-6010)

Transducer Wet Connector Wiring Resistance Check

Visual Inspection: Inspect the pins on the end-cap connector carefully for signs of corrosion or bent pins.

Test the Resistance: Use a DMM to verify the resistance using the cable pin-out (Figure 29) and the Transducer Wet Connector resistance table presented below:

Table 23: Transducer Wet Connector Wiring Resistance Check

Description	XDCR Wet Connector		Resistance	Your Readings
	From	To		
BEAM 1 XMIT to XMIT RTN (see note 8)	1	2	> 1.5 Mohms	
BEAM 2 XMIT to XMIT RTN (see note 8)	3	4	> 1.5 Mohms	
BEAM 3 XMIT to XMIT RTN (see note 8)	5	6	> 1.5 Mohms	
BEAM 4 XMIT to XMIT RTN (see note 8)	7	8	> 1.5 Mohms	
BEAM 1 RCV HI to BEAM 1 RCV LOW (see note 10)	9	10	< 15 ohms	
BEAM 2 RCV HI to BEAM 2 RCV LOW (see note 10)	11	12	< 15 ohms	
BEAM 3 RCV HI to BEAM 3 RCV LOW (see note 10)	13	14	< 15 ohms	
BEAM 4 RCV HI to BEAM 4 RCV LOW (see note 10)	15	16	< 15 ohms	
SHIELD to SHIELD	21	23	> 20 Mohms	
RCV ENABLE to VXDC GND (see note 9)	26	17	4.75 or 99 kohms	
TEMP to TEMP RTN	25	20	11.3 kohms	
VXDC to VXDC GND (see note 6)	24	17	Diode Check Reverse Bias ------------------------------ Forward Bias	
SDAT B to VXDC GND (see note 7)	18	17	5.9 kohms	
SDAT A to VXDC GND (see note 7)	19	17	> 20 Mohms	

Troubleshooting Tips:

1. N/A = Not applicable, no check possible.
2. Some meters will read as OPEN or overload (OL) for resistances greater than 2Mohms. In most cases this is a pass. TRDI recommends using a multimeter that will measure up to 20 MΩ.
3. If the TCM2 voltages are not present, the compass will not work and the system will not operate in high gain mode. Therefore, the system will still collect valid data, but the profiling range will be greatly reduced.
4. If any one of the transmit wires are not correct, then the system will NOT function correctly and MUST be repaired before accurate current data can be collected.
5. If one of the receive wires are not correct, then depending on the failure the system may still be able to function properly with 3 beam solutions.
6. VXDC to VXDC GND - This check needs to be done with the multi-meter in the diode check mode.

   Connect the meter's positive lead to VXDC GND, and the negative lead to VXDC (reverse bias).

   a) Measure a diode drop of ~0.6 VDC, or an overload (OL), depending on the Beamformer assembly version.

   b) Reverse the leads (forward bias) and measure ~ 1.9 VDC.
7. SDATA and SDATB measurements only apply to Ocean Observer systems that have internal TCM2 compasses.
8. Each transmit pair resistance must be greater than 1.5 MΩ, and within 2 MΩ of the resistances on the other three transmit pairs.
9. Measure a resistance of 4.75 K or 99 K, depending on the Beamformer assembly version.
10. OO/OS 38 kHz receive pairs must be < 29Ω. The OO/OS 38 kHz beamformer adds up to 14Ω of internal resistance to each pair of receive lines.

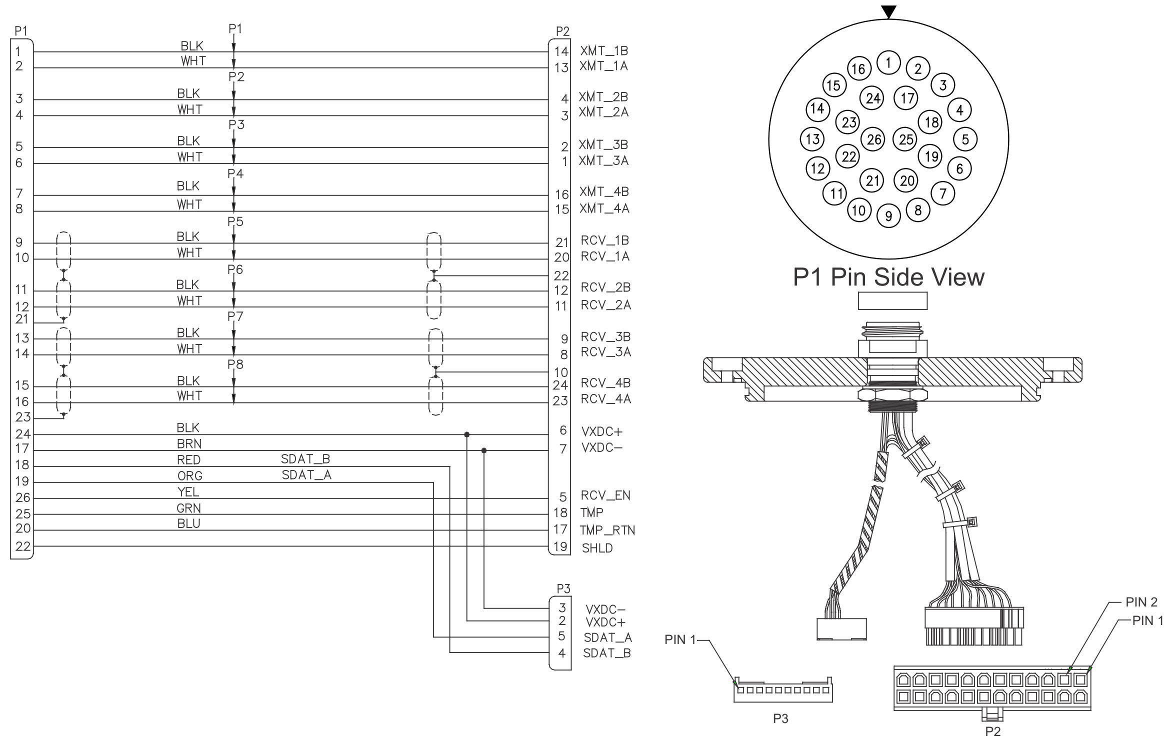


Figure 30. End-Cap Pin-Out and Internal I/O Cable Wiring

Transducer Dry Connector Resistance Check

When only the dry-side connector P2 (Electronics Chassis connector) is accessible and the transducer is connected to the underwater connector P1 (Transducer connector), use Table 24 for a coarse check of the transducer cable's integrity.

Verify the pin-to-pin connections as indicated in the schematic; each connection should have continuity, where the resistance should nominally be 0.033 Ohms per meter of cable length at 20 °C (i.e., a 30 meter cable has a nominal conductor resistance of 1 Ohm at 20 °C). The isolation resistance between conductors, and conductors and shields should be at least 20 MOhm at 100 VDC. Note that if moisture is present you may not be able to obtain this isolation resistance. Use a DMM for measuring the resistance.

Do NOT use a Hi-Pot Tester for measuring the resistance values, as serious damage to the transducer electronics will be the result.

You must observe anti-static precautions for this test since the cable is connected to the transducer.

When the transducer cable is connected to the transducer, you are not able to differentiate between a problem that may exist in the cable or the transducer. That is, if you measure an open connection, the open may be in the cable or the transducer.

Table 24 is valid for an Ocean Surveyor/Ocean Observer Transducer connected and a 30 meter cable length. Other cable lengths may be interpolated. Resistance values are valid at 20 °C.

Table 24: Transducer Dry Connector Resistance Check

Description	Cable Dry Connector		Resistance	Your Readings
	From	To		
BEAM 1 XMIT to XMIT RTN (see note 8)	A	W	> 1.5 Mohms	
BEAM 2 XMIT to XMIT RTN (see note 8)	D	C	> 1.5 Mohms	
BEAM 3 XMIT to XMIT RTN (see note 8)	G	F	> 1.5 Mohms	
BEAM 4 XMIT to XMIT RTN (see note 8)	K	J	> 1.5 Mohms	
BEAM 1 RCV HI to BEAM 1 RCV LOW (see note 10)	e	M	< 15 ohms	
BEAM 2 RCV HI to BEAM 2 RCV LOW (see note 10)	f	N	< 15 ohms	
BEAM 3 RCV HI to BEAM 3 RCV LOW (see note 10)	g	P	< 15 ohms	
BEAM 4 RCV HI to BEAM 4 RCV LOW (see note 10)	h	R	< 15 ohms	
SHIELD to SHIELD	d	q	< 5 ohms	
SHIELD to SHIELD	r	s	< 5 ohms	
SHIELD to SHIELD	d	r	> 20 Mohms	
RCV ENABLE to VXDC GND (see note 9)	S	T	4.75 or 99 kohms	
TEMP to TEMP RTN	i	j	11.3 kohms	
VXDC to VXDC GND (see note 6)	U	T	Diode Check Reverse Bias ------------------------- Forward Bias	
SDAT B to VXDC GND (see note 7)	k	T	5.9 kohms	
SDAT A to VXDC GND (see note 7)	m	T	> 20 Mohms	
SHIELD to ALL	B	ALL	> 20 Mohms	
SHIELD to ALL	E	ALL	> 20 Mohms	
SHIELD to ALL	H	ALL	> 20 Mohms	
SHIELD to ALL	V	ALL	> 20 Mohms	

Troubleshooting Tips:

1. N/A = Not applicable, no check possible.
2. Some meters will read as OPEN or overload (OL) for resistances greater than 2Mohms. In most cases this is a pass. TRDI recommends using a multi-meter that will measure up to 20 MΩ.
3. If the TCM2 voltages are not present, the compass will not work, and the system will not operate in high gain mode. Therefore, the system will still collect valid data, but the profiling range will be greatly reduced.
4. If any one of the transmit wires are not correct, then the system will NOT function correctly, and MUST be repaired before accurate current data can be collected.
5. If one of the receive wires are not correct, then depending on the failure the system may still be able to function properly with 3 beam solutions.
6. VXDC to VXDC GND - This check needs to be done with the multi-meter in the diode check mode.

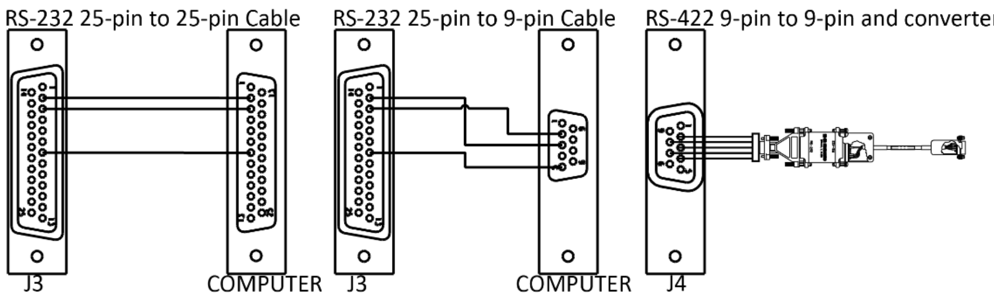
   Connect the meter's positive lead to VXDC GND, and the negative lead to VXDC (reverse bias).

   a) Measure a diode drop of ~0.6 VDC, or an overload (OL), depending on the Beamformer assembly version.

   b) Reverse the leads (forward bias) and measure ~ 1.9 VDC.
7. SDATA and SDATB measurements only apply to Ocean Observer systems that have internal TCM2 compasses.
8. Each transmit pair resistance must be greater than 1.5 MΩ, and within 2 MΩ of the resistances on the other three transmit pairs.
9. Measure a resistance of 4.75 K or 99 K, depending on the Beamformer assembly version.
10. OO/OS 38 kHz receive pairs must be < 29Ω. The OO/OS 38 kHz beamformer adds up to 14Ω of internal resistance to each pair of receive lines.

Serial Data Communications Cables

The provided wiring diagrams and pin-out descriptions of Figure 31 provide the information necessary to connect your host computer to the Ocean Surveyor Electronics Chassis with a minimum of conductors. Off-the-shelf cables may provide more than these minimum connections, but must follow as a minimum the schematics depict in Figure 31. Connectors J3 and J4 are located at the rear panel of the Electronics Chassis, and are used for RS-232 or RS-422 communication respective. Both, RS-232 and RS-422 interfaces are isolated.



Cable Type	ADCP Signal	Chassis	Computer	Computer Signal
RS-232 25-pin to 25-pin	DATA IN DATA OUT GND	2 3 7	2 3 7	DATA OUT DATA IN GND
RS-232 25-pin to 9-pin	DATA IN DATA OUT GND	2 3 7	3 2 5	DATA OUT DATA IN GND
RS-422 9-pin to 9-pin and use a 422 to 232 converter	Chassis GND Rx_422A GND2 Tx_422A Rx_422B Tx_422B	1 2 3 4 7 8	1 2 3 4 7 8	Chassis GND Tx_422A GND2 Rx_422A Tx_422B Rx_422B

Figure 31. Serial Communication Cable Wiring Diagram

These cables provides RS-232 or RS-422 communications. Two cables are provided with the instrument: (1) 25-pin to 25-pin RS-232 cable, and (1) 25-pin to 9-pin RS-232 cable. Each cable is about 2-meters long and has a diameter of 8 mm (0.31 in.).

For cable lengths longer than 15 meters, TRDI recommends using RS-422 communications and a RS-422 to RS-422 converter (see **Figure 32**). The cable for RS-422 communication is not provided with the equipment.

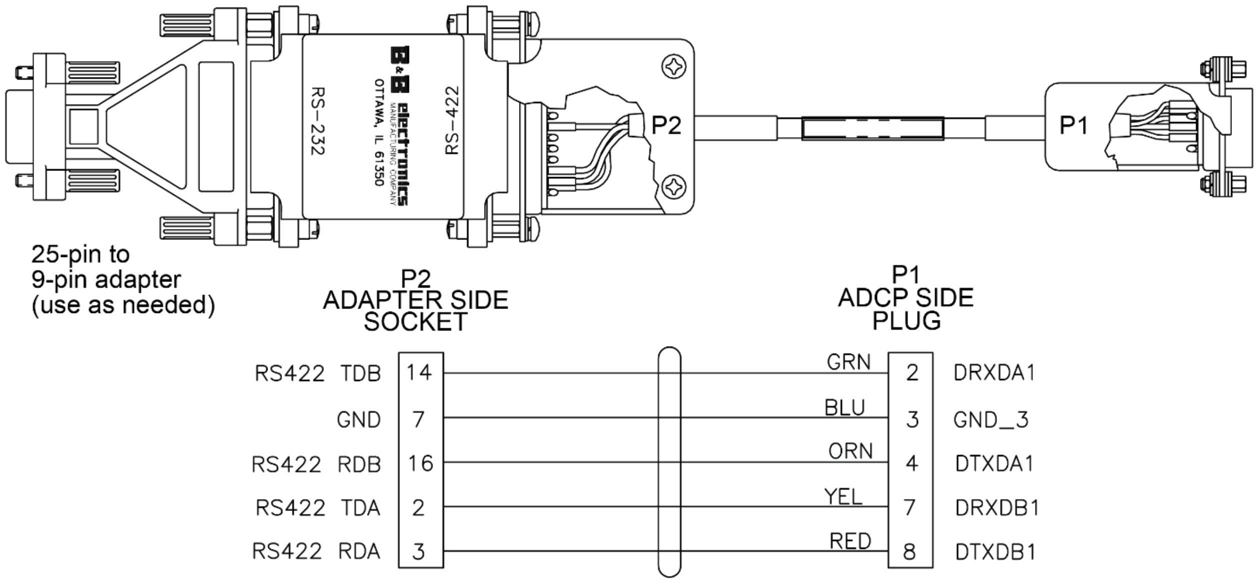


Figure 32. RS-422 to RS-232 Converter Wiring (Part Number 73A-6015-00)

System Overview

This section presents a functional description of the Ocean Surveyor's operation using block diagrams.

Overview of Normal Ocean Surveyor Operation

The following events occur during a typical data collection cycle:

1. The user or a controlling software program sends setup and data collection parameters to the Ocean Surveyor. 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 Ocean Surveyor operation based on the commands received through the serial I/O cable.
2. The Ocean Surveyor Motherboard generates all transmit signals for driving the Quad Transmitter circuit, located on the Power Assembly board. The Transmitter drives the transducer, which projects the acoustic energy into four narrow and directed water columns. Unlike conventional multi beam transducers, these four beams in the Ocean Surveyor are generated during transmit via the transmitter signal phase relationships, and not by separate acoustic projectors.
3. Most backscatter from the water column is generated by zooplankton. The transducer receives echoes from the backscatter. The four receive beams are formed by the Beam Former inside the Transducer assembly. The formed and amplified signals of the four beams are fed to the Electronics Chassis via the Transducer Cable.
4. The Motherboard carries the four receiver channels necessary for amplifying, decoding, and filtering the four beam signals formed by the Beam Former.
5. The filtered signals are then sampled, along with the echo intensity signal, and processed by the Motherboard's Digital Signal processor (DSP).
6. The Thermistor measures the water temperature at the transducer head and sends it to the motherboard.
7. The TCM2 compass located inside the Transducer assembly (Ocean Observer) sends pitch and roll from the tilt sensor and heading from the compass to the Motherboard.

8. The system repeats steps “b” through “g” for a user-defined number of pings. The Motherboard averages the data from each ping to produce an ensemble data set.
9. At the end of the ensemble (sampling) interval, the Motherboard sends the collected data to the serial I/O connector.

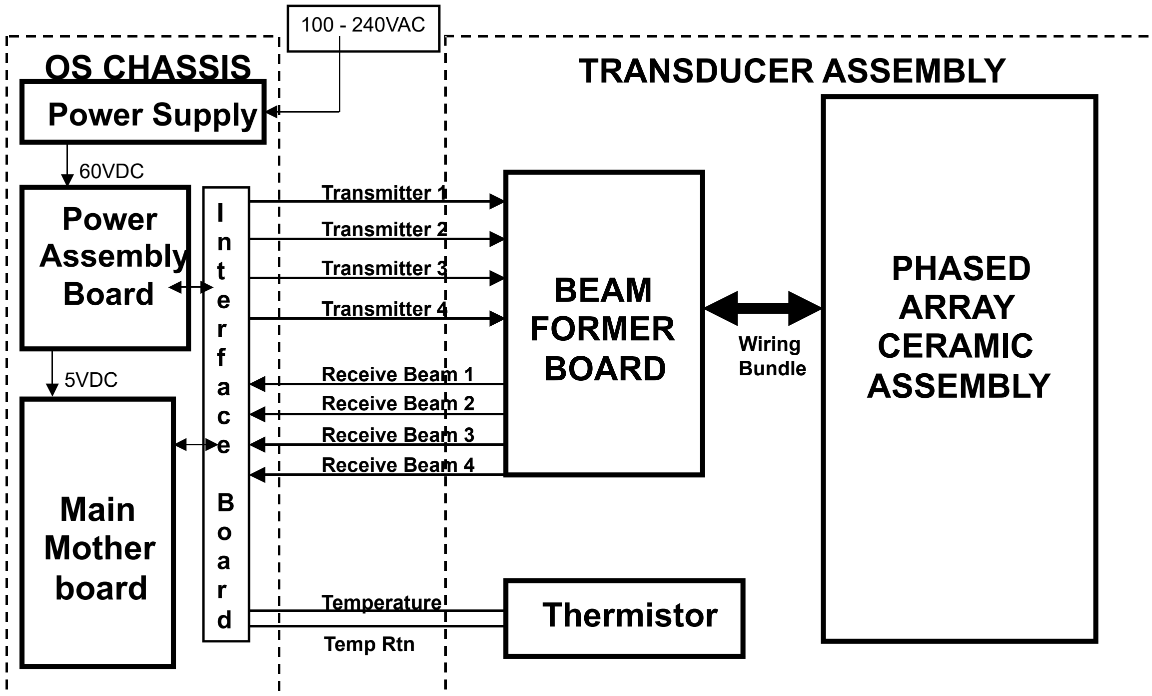


Figure 33. Ocean Surveyor Block Diagram

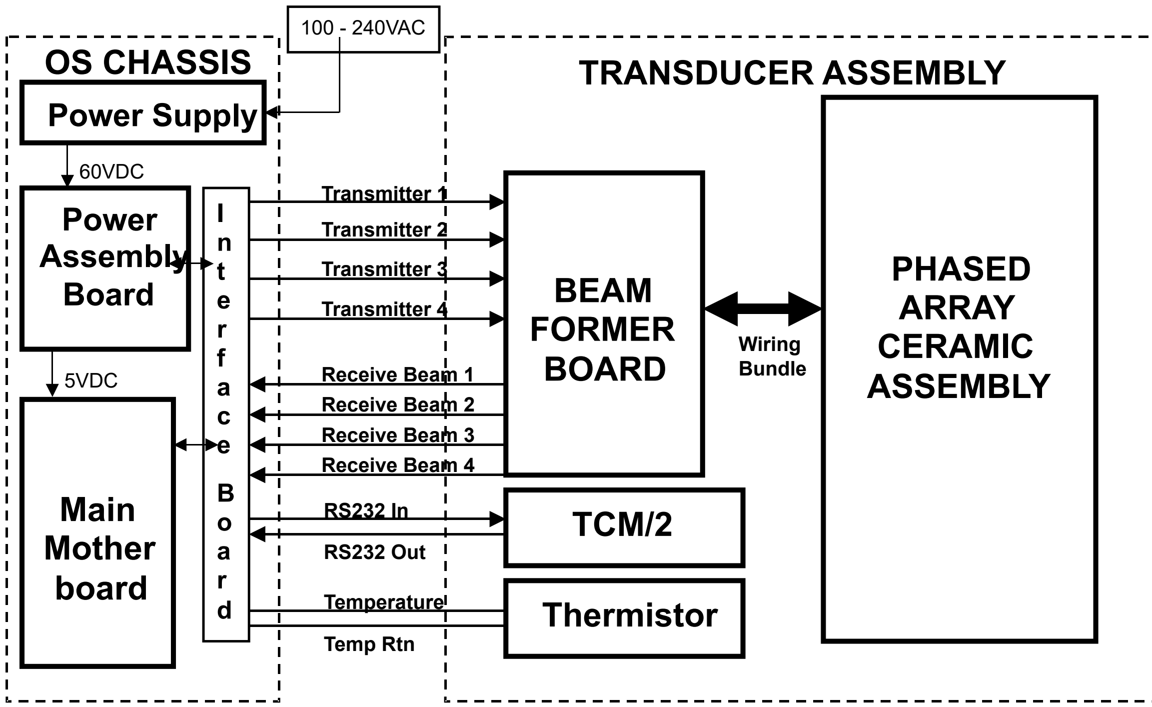


Figure 34. Ocean Observer Block Diagram

Functional Description of Operation

The following sections describe how the Ocean Surveyor operates and interacts with its modules.

Input Power

The Ocean Surveyor Electronic Chassis requires a supply between 90 and 250 V~, and 47 – 63 Hz. A list of pertinent power specification is listed for reference in Table 25.

Table 25: Ocean Surveyor Input Power Requirements.

Input Characteristics	Specification
Mains input voltage range	90 - 250 VAC, 47 - 63 Hz @12A
Mains power between transmit	60 VA
Mains power during transmit	1400 VA
Peak Mains power during transmit	2000 VA (for 4 or less Mains cycles)
Inrush current[1]	17 A rms @ 115 Vac 34 A rms @ 230 Vac
Ride through time[1]	20 ms
Transient surge[1] (Common mode & Normal mode)[1]	EN/IEC 1000-4-2 Level 4 EN/IEC 1000-4-5 Level 3

[1] Obtained from the power supply manufacturer data sheet.

The power supply generates a single 48 VDC supply voltage. It is fed to the Power Assembly. The Power Assembly consists of the Quad Transmitter, a 5-volt DC/DC converter for the Electronics Chassis supply, a 12-volt DC/DC converter for the transducer supply, and the 10 VDC Transmitter gate drive supply. The 48

VDC is also the supply for the transmitter. A single replaceable fuse protects the system from shorts in the transmitter. Self-resetting fuses protect all other supplies.

Board Descriptions

Power Assembly Board:

- Receives the filtered/internal power.
- Limits the in-rush of current to the Ocean Surveyor 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 voltages within the specified range (90 - 250 VAC @12A).
- Converts the operating power supply voltage to power all other Ocean Surveyor circuits.

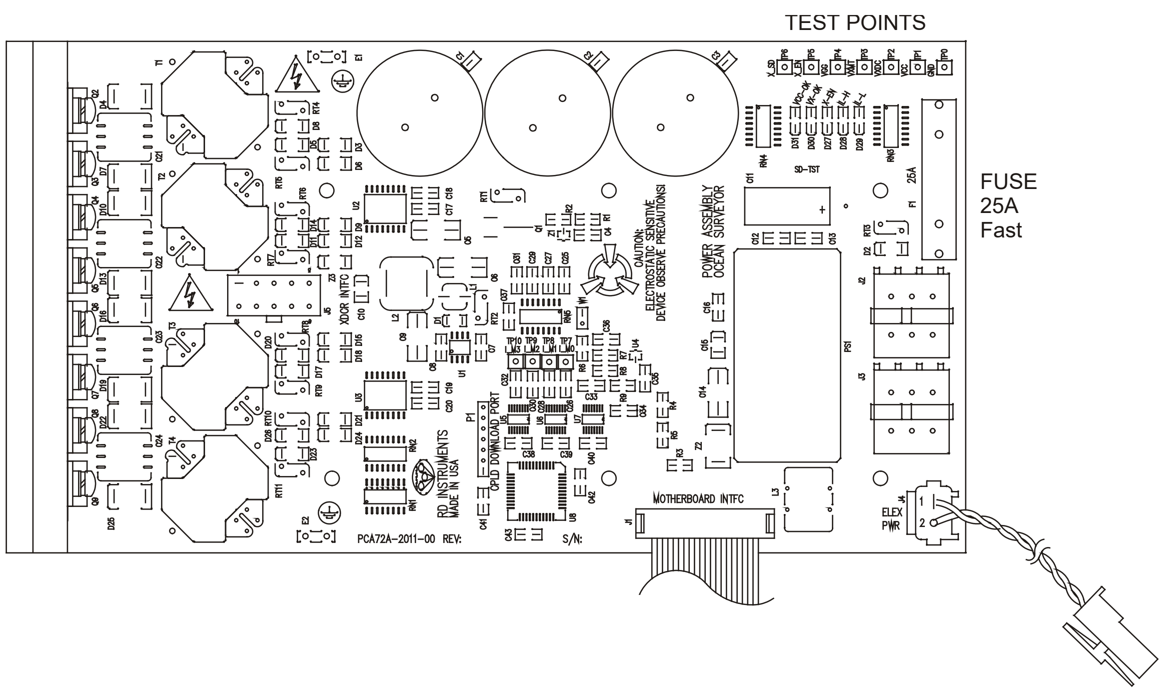


Figure 35. Power Assembly Board

Do NOT ping the Ocean Surveyor/Observer with the transducer in air. The power assembly board will short, causing the electronics chassis to no longer communicate. The transducer is pinged by sending a CS or PT5 command or if *VmDas* is started for collecting data – either of these methods will cause damage if the transducer is in air.

Mother Board:

- Uses the Power Amplifier circuit to generate the high-amplitude pulse AC signal that drives the sonar transducers. The Power Amplifier sends the drive signal to the Beam Former Board (located in the transducer assembly).
- Real time clock.
- Generates most of the timing and logic signals used by the Ocean Surveyor.
- Analog to Digital converter.
- Digitizes information from sensors.

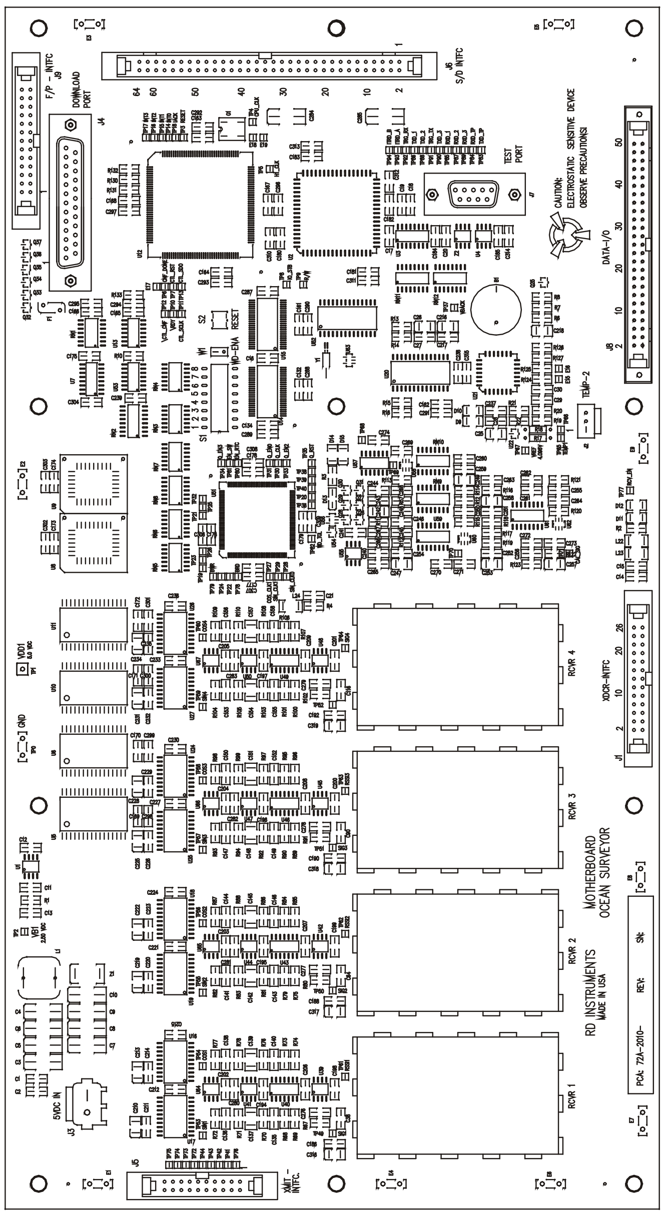


Figure 36. Motherboard

Transducer Interface Board:

- Routs all connections from the transducer cable connector on the rear of the Electronic Chassis to the motherboard.

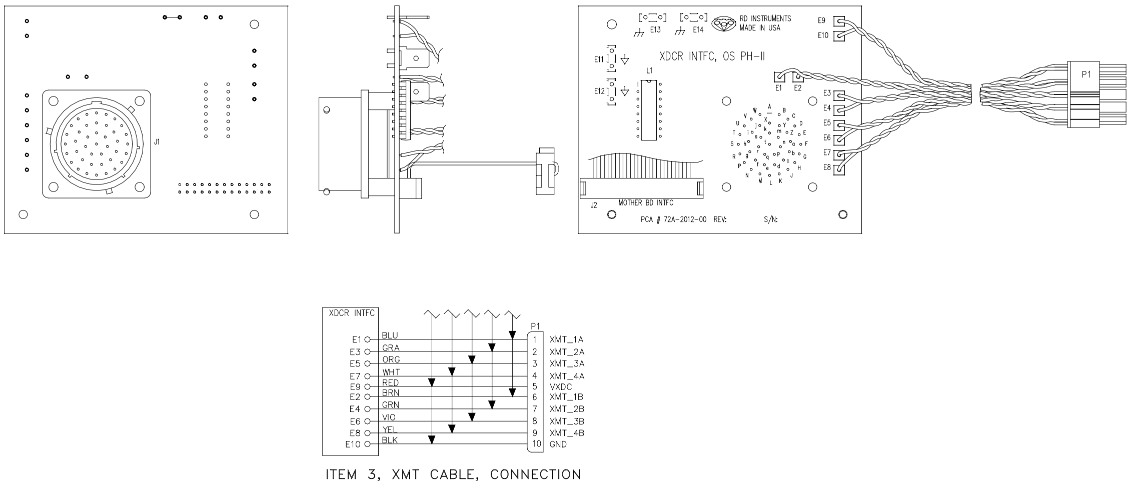


Figure 37. Transducer Interface Board

Data I/O Interface Board:

- Routs all connections from the serial cable connectors on the rear of the Electronic Chassis to the motherboard.

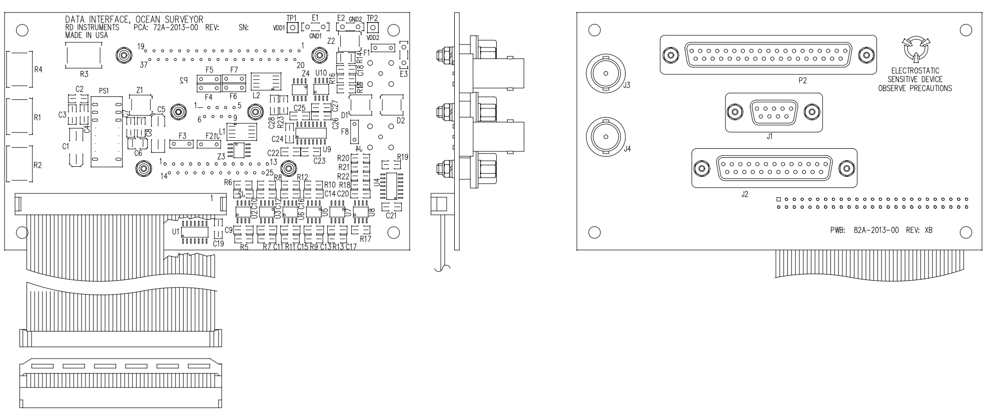


Figure 38. Data I/O Interface Board

TCM2 Board:

- Compass and attitude sensor circuits.

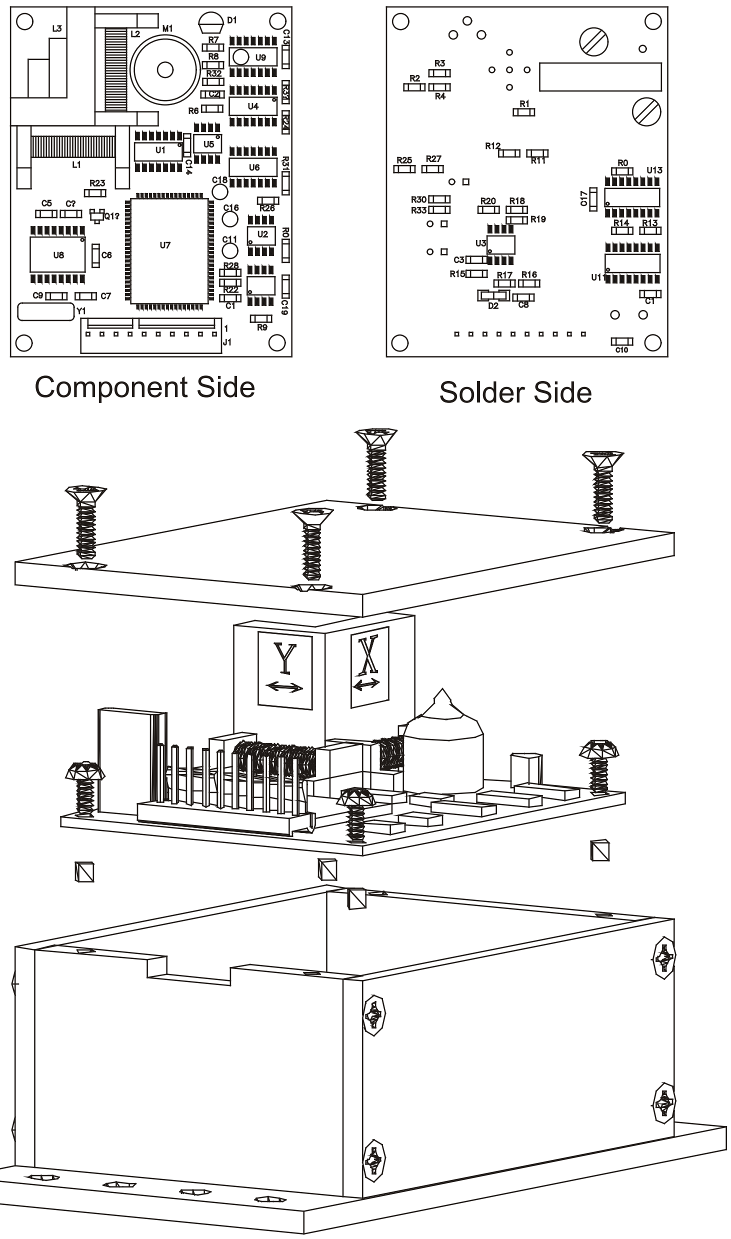


Figure 39. TCM2 Board

Only Ocean Observers have the TCM2 compass installed.

Beam Former Board:

- Tuning functions.
- Receiver functions.
- Temperature sensor.

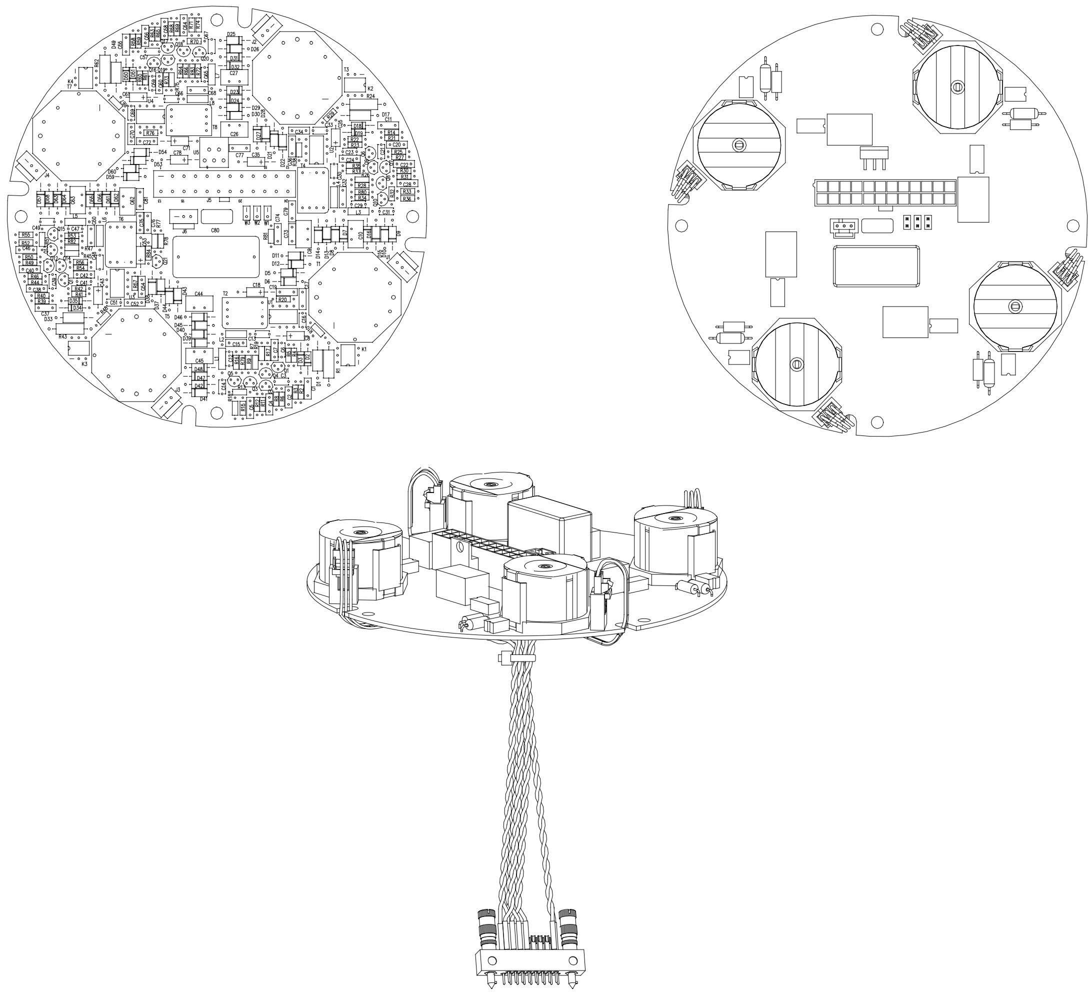


Figure 40. Beam Former Board

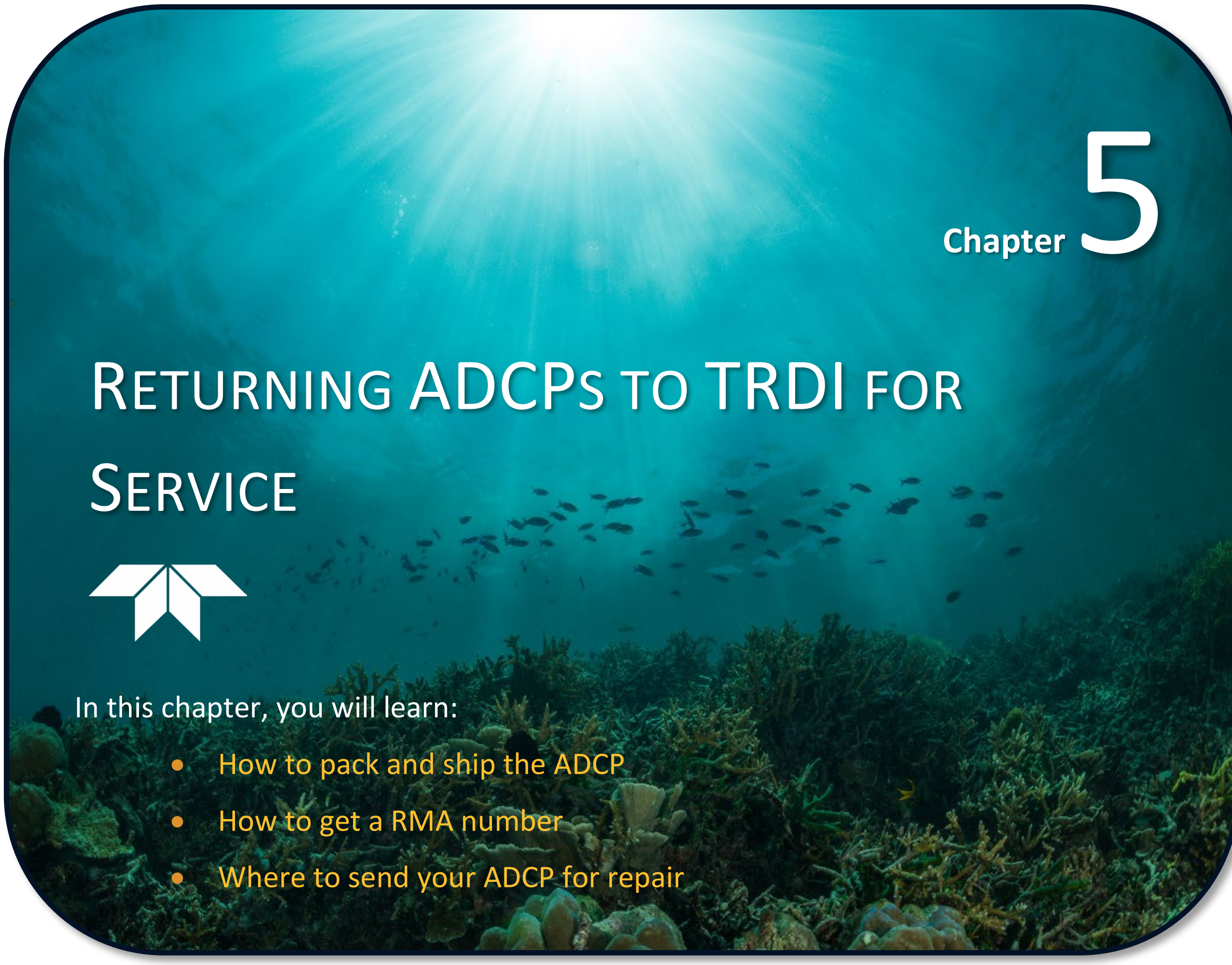
Shock Hazard!

Always treat the array as if it is charged. The array may hold a residual charge created by even minor temperature or pressure changes.

Do not come in contact with any traces on the beamformer board while the P1, P2, P3, and P4 row and column cables are connected. Once the cables are disconnected it is safe to remove the board.

Once the 17-pin Hypertronics cable is removed, use caution to not come in contact with the pins on the connector.

Notes



Chapter 5

RETURNING ADCPS TO TRDI FOR SERVICE

In this chapter, you will learn:

- How to pack and ship the ADCP
- How to get a RMA number
- Where to send your ADCP for repair

Shipping the ADCP

This section explains how to ship the Ocean Surveyor/ Ocean Observer ADCP.

Remove all customer-applied coatings or provide certification that the coating is nontoxic if you are shipping an Ocean Surveyor/ Ocean Observer to TRDI for repair or upgrade. This certification must include the name of a contact person who is knowledgeable about the coating, the name, manufacturer of the coating and the appropriate telephone numbers. If you return the equipment without meeting these conditions, TRDI has 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 Ocean Surveyor/ Ocean Observer ADCP through a Customs facility, be sure to place the unit so identifying labels are not covered and can be seen easily by the Customs Inspector. Failure to do so could delay transit time.

TRDI strongly recommends using the original shipping crate whenever transporting the Ocean Surveyor/ Ocean Observer ADCP.

If you need to ship the Ocean Surveyor/ Ocean Observer ADCP, use the original shipping crate whenever possible. If the original packaging material is unavailable or unserviceable, additional material is available through TRDI.

For repackaging with commercially available materials:

1. Use a strong shipping container made out of wood or plastic.
2. 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.
3. Seal the shipping container securely.
4. Mark the container FRAGILE to ensure careful handing.
5. In any correspondence, refer to the Ocean Surveyor/ Ocean Observer ADCP by model and serial number.

Returning Systems to the TRDI Factory

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

Step 1 - Request a Return Material Authorization

To obtain a Return Material Authorization (RMA) number and shipping instructions for the return of your instrument, do one of the following:

- Contact Customer Service Administration at rdicsadmin@teledyne.com
- Call +1 (858) 842-2700

When requesting a RMA number, please give us the following information:

- What is being shipped (include the serial number)
- When you plan to send the shipment
- What issue(s) need to be corrected
- Name of the Field Service Engineer that knows about the issue
- When you need the instrument returned

TRDI's Customer Service will then respond with the RMA number for the shipment. Please include this number on all packages and correspondence.

Step 2 – Provide a MSDS as necessary

Please provide a Material Safety Data Sheet (MSDS) if the system/transducer is painted with antifouling paint.

Step 3 - Ship via air freight, prepaid

Urgent Shipments should be shipped direct to TRDI via overnight or priority air services. Do not send urgent airfreight as part of a consolidated shipment. If you ship consolidated, it will cost less, 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: Teledyne RD Instruments, Inc. (RMA Number)
14020 Stowe Drive
Poway, California 92064

Airport of Destination = San Diego
UPS Supply Chain Solutions Brokerage
15 E Oregon avenue
Philadelphia PA 19148
USA
Email: phldocreceipt@ups.com
Tel: + 1 (215) 952-1745

Step 4 - Urgent shipments

Send the following information by telephone to TRDI.

Attention: Customer Service Administration

Phone: +1 (858) 842-2600

- 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

Returning Systems to TRDI Europe Factory

When shipping the system to TRDI Europe, the following instructions will help ensure the Sentinel V ADCP arrives with the minimum possible delay. Any deviation from these instructions increases the potential for delay.

Step 1 - Request a Return Material Authorization

To obtain a Return Material Authorization (RMA) number and shipping instructions for the return of your instrument, do one of the following:

- Contact Customer Service Administration at rdiefs@teledyne.com
- Call +33(0) 492-110-930

When requesting a RMA number, please give us the following information:

- What is being shipped (include the serial number)
- When you plan to send the shipment
- What issue(s) need to be corrected
- Name of the Field Service Engineer that knows about the issue
- When you need the instrument returned

TRDI's Customer Service will then respond with the RMA number for the shipment. Please include this number on all packages and correspondence.

Step 2 – Provide a MSDS as necessary

Please provide a Material Safety Data Sheet (MSDS) if the system/transducer is painted with antifouling paint.

Step 3 - Ship Via Air Freight, Prepaid

Urgent Shipments should be shipped direct to TRDI via overnight or priority air services. Do not send urgent airfreight as part of a consolidated shipment. If you ship consolidated, it will cost less, 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.

Mark the package(s) as follows:

To: Teledyne RD Instruments, Inc. (RMA Number)
2A Les Nertieres
5 Avenue Hector Pintus
06610 La Gaude, France

Step 4 - Include Proper Customs Documentation

The Customs statement must be completed. It should be accurate 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.

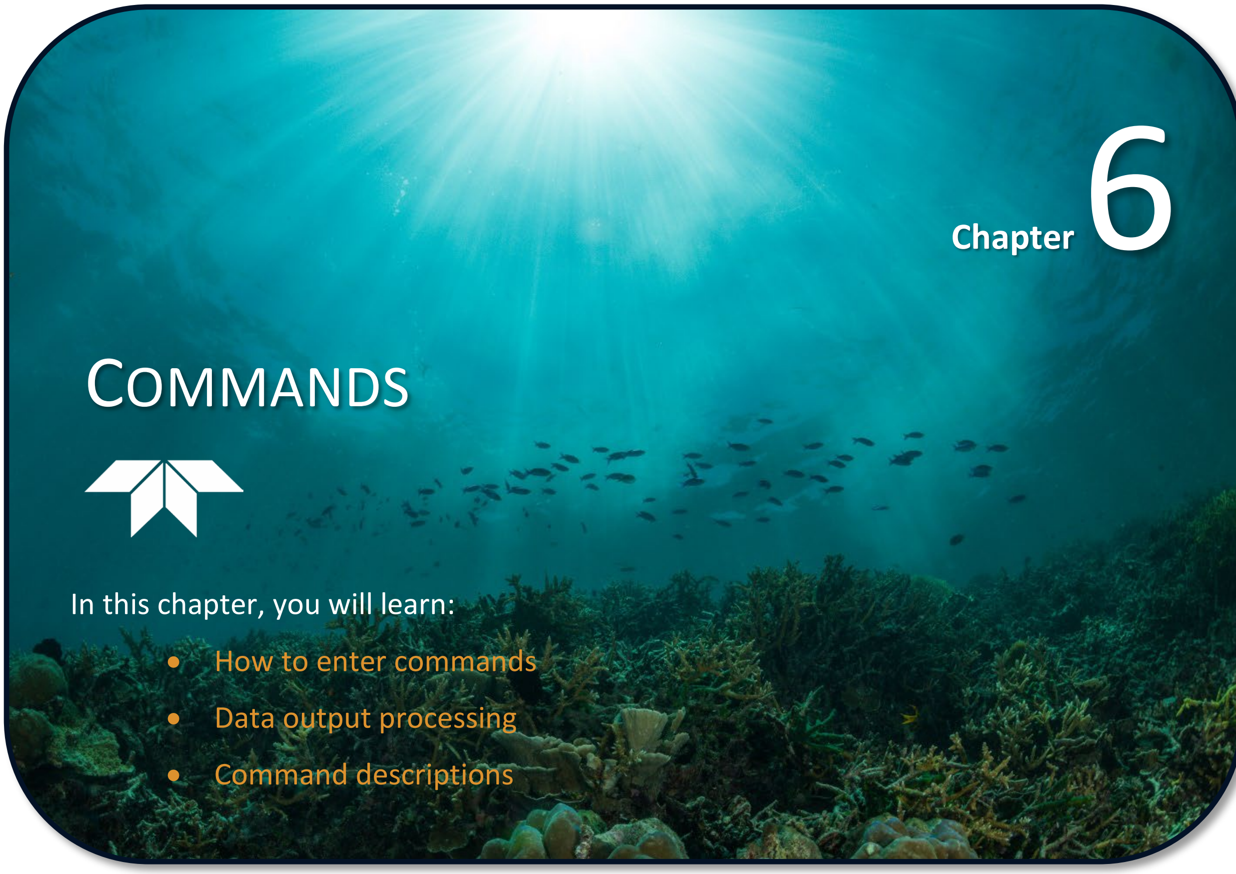
Step 5 - Send the Following Information by Telephone to TRDI

Attention: Sales Administration

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

- 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

NOTES



Chapter 6

COMMANDS

In this chapter, you will learn:

- How to enter commands
- Data output processing
- Command descriptions

This section defines the commands and Output Data Format used by the Ocean Surveyor/Ocean Observer. Most ADCP settings use the factory-set values (Table 27). If you change these values without thought, you could ruin your deployment. *Be sure you know what effect each command has before using it*. Call TRDI if you do not understand the function of any command.

> This guide applies to Ocean Surveyor/Observer firmware version 23.19. When new firmware versions are released, some commands and/or output data formats may be modified or added. Read the README file on the upgrade disk, or check TRDI's web site for the latest changes.

Data Communication & Command Format

You can enter commands with an Windows® compatible computer running a terminal emulator program such as TRDI's *TRDI Toolz*. The ADCP communicates with the computer through an RS-232 or RS-422 serial interface. We initially set the ADCP at the factory to communicate at 9600 baud, no parity, and 1 stop bit.

The ADCP wakes up as soon as power is applied. Sending a BREAK signal from a terminal/program awakens the ADCP (press **End** using *TRDI Toolz*). The BREAK signal must last at least 300 ms. When the ADCP receives a BREAK signal, it responds with a wake-up message similar to the one shown below. The ADCP is now ready to accept commands at the ">" prompt from either a terminal or computer program.

```
Ocean Surveyor Broadband/Narrowband ADCP
Teledyne RD Instruments (c) 1997-2006
All rights reserved
Firmware Version 23.xx

>
```

Command Input Processing

Input commands set ADCP operating parameters, start data collection, run built-in tests (BIT), and asks for output data. All commands (Table 26) are ASCII character(s) and must end with a carriage return (CR). For example,

```
>WP1<CR> [Your input]
```

If the entered command is valid, the ADCP executes the command. If the command is one that does not provide output data, the ADCP sends a line feed <CR> <LF> and displays a new ">" prompt. Continuing the example,

```
>WP1<CR>     [Your original input]
>            [ADCP response to a valid, no-output command]
```

> Where noted, a blank line (<CR> <LF>) is between the command input and before the prompt (>).

If you enter a valid command that produces output data, the ADCP executes the command, displays the output data, and then redisplays the ">" prompt. Some examples of commands that produce output data are ? (help menus), PS (system configuration data), and PA (run built-in tests).

If the command is not valid, the ADCP responds with an error message similar to the following.

```
>WPA<CR>                                   [Your input]
>WPA  ERR 002:  NUMBER EXPECTED<CR><LF>    [ADCP response]
>
```

After correctly entering all the commands for your application, you would send the CS-command (or **TAB**) to begin the data collection cycle.

Data Output Processing

After the ADCP completes a data collection cycle, it sends a block of data called a *data ensemble*. A data ensemble consists of the data collected during the ensemble interval (see TE-command). A data ensemble can contain header, leader, velocity, correlation magnitude, echo intensity, status, and bottom track.

ADCP output data can be in either hexadecimal-ASCII (Hex-ASCII) or binary format (set by CF-command). The Hex-ASCII mode is useful when you use a terminal to communicate with, and view data from the ADCP. The binary mode is useful for reducing the ensemble size to as small as possible for use with a computer program. You would not use the binary mode to view data on a terminal because the terminal could interpret some binary data as control codes.

When data collection begins, the ADCP uses the settings entered last (user settings) or the factory-default settings. The same settings are used for the entire deployment.

The ADCP automatically stores the last set of commands used in RAM. The ADCP will continue to be configured from RAM until it receives a CR-command or until the RAM loses its backup power. If the ADCP receives a CR0 it will load into RAM the command set you last stored in non-volatile memory (semi-permanent user settings) through the CK-command. If the ADCP receives a CR1, it will load into RAM the factory default command set stored in ROM (permanent or factory settings).

Table 26 gives a summary of the ADCP input commands, their format, and a brief description of the parameters they control. The factory default command settings are listed in Table 27.

Table 26: ADCP Input Command Summary

Command	Description
?	Shows Command Menu
<BREAK>	Interrupts or wakes up Ocean Surveyor and loads last settings used
===	Soft break
V	Display banner
BAnnn	Bottom Track Amplitude Threshold (0 to 255 counts)
BCnnn	Bottom Track Correlation Threshold (0 to 255 counts)
BEnnnn	Bottom Track Error Velocity Threshold (0 to 9999 mm/s)
BPn	Bottom Track Pings (0 = disable, 1 to 999 = number of pings)
BXnnnn	Bottom Track Maximum Tracking Depth (0 to 65535 dm)
CBnnn	Serial Port Control (Baud Rate/Parity/Stop Bits)
CCn	Suppress Pair (0 = none, 1 = beam pair 1&2, 3 = beam pair 3&4, 4 = both pairs (all beams))
CFabcde	Flow Control (a = ensemble cycling, b = ping cycling, c= binary/ASCII, d = serial port, e = not used)
CK	Keep Parameters as User Defaults
CMn	Suppress Beam (0 = No beam suppressed, 1-4 = number of beam to suppress)
CRn	Retrieve Parameters (0 = User, 1 = Factory)
CS	Start Pinging
CUn	Use Calibrated RSSI (0 = raw, 1 = calibrated)
CWn	Select Dual Mode Data (0 = BroadBand, 1 = NarrowBand)
CXn,n,nnnnn	Trigger Mode (In, Out, Timeout)
EA±nnnnn	Heading Alignment (-17999 to 18000)
ECnnnn	Speed of Sound (1400 to 1600 m/s)
EDnnnnn	Depth of Transducer (0 to 65535 decimeters)
EEnnnnnn	Attitude Data Output and Interpolation
EF±nnn	External Pitch/Roll Factor (-99 to 99)
EHnnnnn,n	Heading Angle (heading (0 to 36000); frame (0 = instrument coordinates, 1 = ship coordinates))
EI±nnnnn	Roll Misalignment Angle (-17999 to 18000)
EJ±nnnnn	Pitch Misalignment Angle (-17999 to 18000)
EP±nnnn, ±nnnn,z	Tilts (pitch (-17999 to 18000), roll (-17999 to 18000), frame (0 = instrument coordinates, 1 = ship coordinates))
ER±nnnn	Roll (tilt 2) angle (-6000 to +6000 degrees)
ESnn	Salinity (0 to 50)
ET±nnnn	Temperature in °C (-500 to + 4000)

Table 26: ADCP Input Command Summary

Command	Description
EUn	Orientation (0 = Down, 1 = Up)
EV±nnnnnn	Heading Bias (-17999 to 18000)
EXnnnnn	Coordinate Transformations
EZcdhprstu	Sensor Source (c = Speed of sound, d = Depth, h = Heading, p = Pitch (tilt 1), r = Roll (tilt 2), s = Salinity, t = Temperature, u = Up/Down Orientation); (0 = manual, 1 = transducer, 2 = synchro)
LC	Clear Fault Log
LD	Display Fault Log
LL	Display Fault List
NAnnn	Narrow Bandwidth Profiling Mode False Target Amplitude Threshold (0 to 255 counts)
NDabc def ghi	Narrow Bandwidth Profiling Mode Data Out (a = velocity, b = power, c = echo intensity, d = percent good, e = status, f to i = reserved)
NEnnnn	Narrow Bandwidth Profiling Mode Error Velocity Threshold (0 to 9999 mm/s)
NFnnnn	Narrow Bandwidth Profiling Mode Blanking Distance (maximum = 9999 cm, minimum 80 cm for 38 kHz, 40 cm for 75 kHz, 20 cm for 150 kHz)
NNnnn	Narrow Bandwidth Profiling Mode Number of bins (1 to 128 bins)
NPnnn	Narrow Bandwidth Profiling Mode Number of Pings (0 to 999 pings)
NSnnnn	Narrow Bandwidth Profiling Mode Bin Size (0800 to 6400 cm for 38 kHz, 800 to 3200 cm for 75 kHz, 400 to 1600 cm for 150 kHz)
PA	Runs Built-In tests
PCn	Show Sensor Data (0 = help, 2 = sensor data)
PDn	Data Stream Select (n = 0)
PSn	Display System Parameters (0 = Sys Configuration, 1 = fixed leader, 2 = variable leader, 4 = ping sequence)
PTn	Diagnostic Tests (0 = help, 3 = receive path, 5 = electronic wrap around, 6 = receive bandwidth)
TC	System Timer Value
TEhh:mm:ss.ff	Time per Ensemble (hh = hours, mm = minutes, ss = seconds, ff = hundredths of seconds)
TPmm:ss.ff	Time Between Pings (mm = minutes, ss = seconds, ff = hundredths of seconds)
TSyymmddhhmmss	Set System Date and Time (Year/Month/Day, Hour: Minute: Second)
WAnnn	Broad Bandwidth Profiling Mode False Target Amplitude Threshold (0 to 255 counts)
WCnnn	Broad Bandwidth Profiling Mode Correlation Threshold (0 to 255 counts)
WDabc def ghi	Broad Bandwidth Profiling Mode Profile Data Out (a = Velocity; b= Correlation; c = Intensity; d = percent good, e = Status, f to i = reserved)
WEnnnn	Broad Bandwidth Profiling Mode Error Velocity Threshold (0 to 9999 mm/s)
WFnnnn	Broad Bandwidth Profiling Mode Blanking Distance (maximum = 9999 cm, minimum 80 cm for 38 kHz, 40 cm for 75 kHz, 20 cm for 150 kHz)
WNnnn	Broad Bandwidth Profiling Mode Number of bins (1 to 128 bins)
WPnnn	Broad Bandwidth Profiling Mode Number of Pings (0 to 999 pings)
WSnnnn	Broad Bandwidth Profiling Mode Bin Size (400 to 6400 cm for 38 kHz, 200 to 3200 cm for 75 kHz, 400 to 1600 cm for 150 kHz)
WVnnn	Broad Bandwidth Profiling Mode Ambiguity Velocity (0 to 9999 cm/s)

Table 27: ADCP Factory Defaults

COMMAND	38.8 kHz	75 kHz	150 kHz
BAnnn	30	30	30
BCnnn	220	220	220
BEnnnn	1000	1000	1000
BPnnn	0 (Stationary) 1 (Vessel)	0 (Stationary) 1 (Vessel)	0 (Stationary) 1 (Vessel)
BXnnnn	20000	11500	07200
CBabc	411	411	411
CFabcde	11110	11110	11110
CCn	0	0	0
CMn	0	0	0
CUn	1	1	1
CWn	1	1	1
CXn,n,nnnnn	0,0,00000	0,0,00000	0,0,00000
EA±nnnnn	0	0	0
ECnnnn	1500	1500	1500
EDnnnnn	0	0	0
EEnnnnnn	111110	111110	111110
EF±nn	1	1	1
EH±xxxx,y	0,0 (Stationary) 0,1 (Vessel)	0,0 (Stationary) 0,1 (Vessel)	0,0 (Stationary) 0,1 (Vessel)
EI±nnnnn	0	0	0
EJ±nnnnn	0	0	0
EP±xxxx, ±nnnn,z	0,0,0 (Stationary) 0,0,1 (Vessel)	0,0,0 (Stationary) 0,0,1 (Vessel)	0,0,0 (Stationary) 0,0,1 (Vessel)
ER±nnnn	0000	0000	0000
ESnn	35	35	35
ET±nnnn	2100	2100	2100
EUn	0	0	0
EV±nnnnn	0	0	0
EXnnnnn	00000	00000	00000
EZnnnnnnn	1011101	1011101	1011101
NAnnn	255	255	255
NDnnnnnnnnn	111110000	111110000	111110000
NEnnnn	1000	1000	1000
NFnnnn	1600	800	400
NNnnn	050	050	050
NPnnn	000	000	000
NSnnnn	3200	1600	800
PDn	0	0	0
TEhhmmssff	00000000	00000000	00000000
TPmmssff	000300	000200	000100
WAnnn	255	255	255
WCnnn	120	120	120
WDnnn nnn nnn	111 110 000	111 110 000	111 110 000
WEnnnn	1000	1000	1000
WFnnnn [min]	1600	800	400
WNnnn	50	50	50
WPnnn	1	1	1
WSnnnn	3200	1600	800
WVnnnn	390	390	390

Table 26 and Table 27 apply to the Ocean Surveyor firmware version 23.17.

Command Descriptions

This section lists all ADCP commands. Each listing includes the command's purpose, format, range, and description. When appropriate, we include amplifying notes and examples. If a numeric value follows the command, the ADCP uses it to set a processing value (time, range, percentage, processing flags). All measurement values are in metric units (mm, cm, dm).

Miscellaneous Commands

? - Help Menus

Purpose Lists the major help groups.

Format See description

Description Entering ? by itself displays the command groups (deploy and System). To display help for one command group, enter *x*?, where *x* is the command group you wish to view. When the ADCP displays the help for a command group, it also shows the format and present setting of those commands. To see the help or setting for one command, enter the command name followed by a question mark. For example, to view the WP-command setting enter WP?.

Examples See below.

```
>?
Available Commands:

@ ------------------------------ Special Commands
& ------------------------------ Engineering Test Commands
# ------------------------------ Expert Commands
B ------------------------------ Bottom Track Commands
C ------------------------------ Control Commands
E ------------------------------ Environment Commands
L ------------------------------ Fault Log Commands
N ------------------------------ Narrow Band Mode Commands
P ------------------------------ Performance Test Commands
T ------------------------------ Time Commands
V ------------------------------ Display Banner
W ------------------------------ Water Profiling Commands
? ------------------------------ Display Main Menu
```

The Special @, &, and # commands are for TRDI use only and are not documented in this manual.

Break

Purpose Interrupts the ADCP without erasing present settings.

Format <BREAK>

Description A BREAK signal interrupts ADCP processing. It is falling-edge triggered and the transition must last at least 300 ms. A BREAK initializes the system, returns a wake-up (copyright) message, and places the ADCP in the DATA I/O mode. The BREAK command does not erase any settings or data. Using *TRDI Toolz*, pressing the **End** key sends a BREAK.

Example <BREAK>

```
Ocean Surveyor Broadband/Narrowband ADCP
Teledyne RD Instruments (c) 1997-2000
All rights reserved
Firmware Version 23.xx

>
```

There is a blank line (<CR> <LF>) between the last line of the wakeup message and before the prompt (>).

Soft Break

Purpose Interrupts the ADCP without erasing present settings.

Format = = =

Description The user can enter three consecutive equal signs (= = =) to get the same effect as pressing the **End** key on a PC keyboard when running *TRDI Toolz*.

Example = = =

```
Ocean Surveyor Broadband/Narrowband ADCP
Teledyne RD Instruments (c) 1997-2000
All rights reserved
Firmware Version 23.xx

>
```

There is a blank line (<CR> <LF>) between the last line of the wakeup message and before the prompt (>).

V - Display Banner

Purpose Displays the (wakeup message)

Format V

Description Only displays the banner message. This command does not wakeup the ADCP.

Example See below.

```
>v
Ocean Surveyor Broadband/Narrowband ADCP
Teledyne RD Instruments (c) 1997-2006
All rights reserved.
Firmware Version: 23.xx

>
```

There is a blank line (<CR> <LF>) between the last line of the banner message and before the prompt (>).

Bottom-Track Commands

The Ocean Surveyor uses these commands for bottom-tracking applications. Bottom-track (BT) commands tell the ADCP to collect speed-over-bottom data and detected range-to-bottom data. Bottom Tracking is ON (BP1) by default. Sending a zero BP-command (BP0) turns off the bottom-tracking process.

Available Bottom-Track Commands

This section lists the available Bottom Track commands.

```
>b?
Available Commands:

BA 030 -------------------------- Amplitude Threshold [0..255]
BC 220 -------------------------- Correlation Threshold [0..255]
BE 1000 ------------------------- Error Velocity Threshold (mm/s)
BP 1 ---------------------------- Number of BT Pings in an ensemble
BX 20000 ------------------------ Max Depth (dm)
B? ------------------------------ Display B-Command Menu
```

Bottom-Track Command Descriptions

BA - Amplitude Threshold

Purpose Sets the minimum value for a valid bottom detection.

Format BA*nnn*

Range *nnn* = 0 to 255 counts

Default BA030

Recommended Setting. The default setting for this command is recommended for most applications.

Description BA sets the minimum amplitude of an internal bottom-track filter that determines bottom detection. Reducing BA increases the bottom-track detection range, but also may increase the possibility of false bottom detections.

BC - Correlation Threshold

Purpose Sets minimum correlation magnitude for valid velocity data.

Format BC*nnn*

Range *nnn* = 0 to 255 counts

Default BC220

Recommended Setting. The default setting for this command is recommended for most applications.

Description Sets a minimum threshold for good bottom-track data. The ADCP flags as bad any bottom-track data with a correlation magnitude less than this value.

A count value of 255 is a perfect correlation (i.e. a solid target).

BE - Error Velocity Threshold

Purpose Sets maximum error velocity for good bottom-track water-current data.

Format BE*n*

Range *n* = 0 to 9999 mm/s

Default BE1000

Recommended Setting. The default setting for this command is recommended for most applications.

Description The ADCP uses this parameter to determine good bottom-track velocity data. If the error velocity is greater than this value, the ADCP marks as bad all four beam velocities (or all four coordinate velocities, if transformed). If three beam solutions are allowed (see EX-command) and only three beams are good, then the data is accepted since four good beams are needed for error velocity calculation.

The default setting is set purposely high. We recommend extreme caution and testing before changing this setting. Data rejected by this command is lost and cannot be regained.

BP - Bottom-Track Pings

Purpose Sets the number of bottom-track pings to average together in each data ensemble.

Format BP*n*

Range *n* = 0 to 999 pings

Default BP0 (Stationary), BP1 (Vessel)

Recommended Setting. The default setting for this command is recommended for most applications.

Description BP sets the number of bottom-track pings to average together in each ensemble before sending/recording bottom-track data.

The ADCP interleaves bottom-track pings with water-track pings (see TP - Time Between Pings) with the bottom track ping being the first ping in an ensemble.

If BP = zero, the ADCP does not collect bottom-track data.

BX - Maximum Tracking Depth

Purpose Limits the search range for bottom tracking.

Format BX*nnnn*

Range *nnnn* = 0 to 65535 decimeters (meters x 10)

Default BX20000 (38 kHz), BX11500 (75 kHz), BX07200 (150 kHz)

Recommended Setting. The default setting for this command is recommended for most applications.

Description BX sets the maximum tracking depth used by the ADCP during bottom tracking. This prevents the ADCP from searching too long, and too deep for the bottom, allowing a faster ping rate when the ADCP loses track of the bottom.

Example If you know the maximum depth in the deployment area is 500 meters (5000 decimeters), set BX to a value slightly larger than 5000 dm, say 5250 dm, instead of 9999 dm. Now if the ADCP loses track of the bottom, it will stop searching for the bottom at 5250 dm (525 m) rather than spend time searching down to 9999 dm (999.9 m).

The BX command limits the search range for bottom tracking. If the ADCP loses lock on the bottom, it goes into search mode, which iteratively searches increasing ranges until either the bottom is found or the maximum range is reached, and then the process starts over at the minimum range. The BX command will prevent the ADCP from searching to ranges beyond the BX range value, and can result in shorter search cycles if the bottom is known to be within this range.

In addition to limiting the search range, the BX command indirectly limits the bottom track range. While this does not prevent the ADCP from bottom tracking to ranges beyond the BX range, use caution in setting this command to less than the expected maximum depth as the ADCP will be less likely to hold a lock on the bottom if there is any slope beyond the BX range.

Control System Commands

The Ocean Surveyor uses the following commands to control certain system parameters.

Available Control System Commands

This section lists the available Control System commands.

```
>c?
Available Commands:

CB 411 ----------------------- Serial Port Control {baud;parity;stop}
CC 0 ------------------------ Suppress Pair(s) [0=none, 1=1-2, 3=3-4, 4=all]
CD 00000000 ----------------- Set Debug Flag
CF 11110 -------------------- Set Ctrl Flags {e;p;b;s;*}
CK -------------------------- Save Command Parameters to Flash
CM 0 ------------------------ Suppress Beam [0=none]
CR -------------------------- Restore Cmd defaults [0=user,1=factory]
CS -------------------------- Start Pinging
CU 0 ------------------------ Use calibrated RSSI [0=raw,1=calibrated]
CW 1 ------------------------ Select dual mode data [0=broad,1=narrow]
CX 0,0,00000 ---------------- Set Trigger Mode {in;out;[timeout]}
C? -------------------------- Display C-Command Menu
```

Control System Command Descriptions

CB - Serial Port Control

Purpose Sets the RS-232/422 serial port communications parameters (Baud Rate/Parity/Stop Bits).

Format CB*abc*

Range *a* = baud rate, *b* = parity, *c* = stop bits (see description)

Default CB411

Recommended Setting. The default setting for this command is recommended for most applications.

Description The ADCP and your external device (dumb terminal, computer software) MUST use the same communication parameters to *talk* to each other. After you enter valid CB parameters, the ADCP responds with a “>” prompt. You may now change the external device’s communication parameters to match the ADCP parameters before sending another command (see Table 28).

Table 28: Serial Port Control

Baud Rate	Parity	Stop Bits
1 = 1200	1 = None	1 = 1 Bit
2 = 2400	2 = Even	2 = 2 Bits
3 = 4800	3 = Odd	
4 = 9600 (Default)		
5 = 19200		
6 = 38400		
7 = 57600		
8 = 115200		

Setting the Baud Rate in the ADCP. The ADCP can be set to communicate at baud rates from 1200 to 115200. The factory default baud rate is always 9600 baud. The baud rate is controlled via the CB-command. The following procedure explains how to set the baud rate and save it in the ADCP. This procedure assumes that you will be using the program *TRDI Toolz* that is supplied by Teledyne RD Instruments.

1. Connect the ADCP to the computer and apply power (see the Ocean Surveyor/Observer User's Guide).
2. Start the *TRDI Toolz* program and wakeup the ADCP by sending a break signal with the **End** key.
3. Send the command CR1 to place the ADCP in the factory default setup.
4. Send the CB-command that selects the baud rate you wish. The following are the typical CB-command settings for different baud rates with no parity and 1 stop bit:

Table 29: Baud Rate

Baud Rate	CB-Command
1200	CB111
2400	CB211
4800	CB311
9600	CB411 (Default)
19200	CB511
38400	CB611
57600	CB711
115200	CB811

5. On the **File** menu, click **Options** to open the *TRDI Toolz* communication port setup window. Change the communication port settings to match your new CB command setting.
6. Press **OK** to exit the communication port setup window. The ADCP is now set for the new baud rate. The baud rate will stay at this setting until you send a <break>. To permanently save the new baud rate, send the CK command. The baud rate will stay at this setting even when you send a CR1 command.

CC – Suppress Pair

Purpose: This command is used for troubleshooting only. It is used to disable the beam planes. This command applies only to Broadband pings (i.e. WP > 0 or BP > 0).

Format: CC*n*

Range: *n* = 0 (none)
n = 1 (beam pair 1 & 2)
n = 3 (beam pair 3 & 4)
n = 4 (both pairs (all beams))

Default: CC0

Recommended Setting. The default setting for this command is recommended for most applications.

Description: This command is used to suppress either none, either plane (pair of beams), or all beams. The disabled beams' ensemble velocity output is set to -32768. Sending a BREAK or CR1 command resets the CC command to CC0.

Use CC4 to turn the transmitter off for bench testing the attitude sensor with the transducer out of water. This is necessary because the electronics can be damaged if pinging is done with the transducer out of water.

Table 30: Beam Suppression

Command	Description
CC0	CC0 is normal operation with no beams suppressed. Sending a BREAK or CR1 resets the command to CC0 to make it very difficult to accidentally deploy while suppressing beams.
CC1	CC1 disables beam pair 1 and 2 completely. Beams 1 and 2 velocities, RSSIs, and correlations are marked BAD with -32768, 0, and 0 respectively. Beams 3 and 4 collect normal BEAM data.
CC3	CC3 disables beam pair 3 and 4 completely. Beams 3 and 4 velocities, RSSIs, and correlations are marked BAD with -32768, 0, and 0 respectively. Beams 1 and 2 collect normal BEAM data.
CC4	CC4 is not typically a user command. It is there for system tests and does the following. a) Disables all beam transmissions, b) Sets all velocities to BAD, -32768, c) Calculates and outputs RSSIs and Correlations.

The CC command is only to be used with BEAM coordinate frame.
There is a blank line (<CR> <LF>) after the CC command entry and before the prompt (>).

CF - Flow Control

Purpose Sets various ADCP data flow-control parameters.

Format CF*abcde*

Range *a* = ensemble cycling, *b* = ping cycling, *c*= binary/ASCII, *d* = serial port, *e* = not used

Default 11110

Recommended Setting. The default setting for this command is recommended for most applications.

Description CF defines whether the ADCP: generates data ensembles automatically or manually; generates pings immediately or manually; sends serial output data in binary or Hex-ASCII format; sends or does not send output data to the serial interface (see Table 31).

Table 31: Flow Control

Command	Description
CF1xxxx	Automatic Ensemble Cycling – Automatically starts the next data collection cycle after the current cycle is completed. Only a <BREAK> can stop this cycling.
CF0xxxx	Manual Ensemble Cycling – Enters the STANDBY mode after transmission of the data ensemble, displays the “>” prompt, and waits for a new command.
CFx1xxx	Automatic Ping Cycling – Pings immediately when ready.
CFx0xxx	Manual Ping Cycling – Sends a “<” character to signal ready to ping, and then waits to receive an <Enter> before pinging. The <Enter> sent to the ADCP is not echoed. This feature lets you manually control ping timing within the ensemble.
CFxx1xx	Binary Data Output – Sends the ensemble in binary format, if serial output is enabled (see below).
CFxx0xx	Hex-ASCII Data Output – Sends the ensemble in readable hexadecimal-ASCII format, if serial output is enabled (see below).

Command	Description
CFxxx1x	Enable Serial Output – Sends the data ensemble out the RS-232/422 serial interface.
CFxxx0x	Disable Serial Output – No ensemble data are sent out the RS-232/422 interface.
CFxxxx1	Not used
CFxxxx0	Not used
Example	CF11110 (default) selects automatic ensemble cycling, automatic ping cycling, Binary data output, and enables serial output.

The VmDas program sets the Ocean Surveyor to a manual ensemble mode (CF01110) so that it controls when the ensemble occurs.

There is a blank line (<CR> <LF>) after the CF command entry and before the prompt (>) only when attempting to set the CF command to an invalid value.

CK - Keep Parameters

Purpose Stores present parameters to non-volatile memory.

Format CK

Description CK saves the present user command parameters to non-volatile memory. The ADCP maintains data stored in the non-volatile memory (user settings) even if power is lost. You can recall parameters stored in non-volatile memory with the CR0-command. When CR0 is sent, the command set is restored to values previously saved to non-volatile memory.

There is a blank line (<CR> <LF>) after the CK command entry and before the prompt (>).

CM – Suppress Beam

Purpose Used to disable one of the ADCP's beams.

Format CM*n*

Range *n* = 0 to 4 (0 = No beam suppressed, 1 to 4 = number of beam to suppress)

Default CM0

Recommended Setting. The default setting for this command is recommended for most applications.

Description Used to disable a beam that cannot provide useful information, for example, a beam that is permanently obstructed. The disabled beam's ensemble velocity output is set to BAD, -32768 and the correlation and RSSI values are set to zero.

CR - Retrieve Parameters

Purpose Retrieves the command set from non-volatile memory or restores factory defaults.

Format CR*n*

Range *n* = 0 (User) to 1 (Factory Default)

Description If *n* is zero, than the command set previously stored with the CK command is retrieved from non-volatile memory. If *n* is one, then the factory default commands are restored.

CR keeps the present baud rate and does not change it to the value stored in non-volatile memory or ROM. This ensures the ADCP maintains communications with the computer.

CS - Start Pinging (Go)

Purpose Starts the data collection cycle.

Format CS

Description The ADCP starts data collection. While collecting data, the ADCP will ignore further commands unless a <BREAK> is sent to interrupt data collection.

Do NOT ping the Ocean Surveyor/Observer with the transducer in air. The power assembly board will short, causing the electronics chassis to no longer communicate. The transducer is pinged by sending a CS or PT5 command or if *VmDas* is started for collecting data – either of these methods will cause damage if the transducer is in air.

CU – Use Calibrated RSSI

Purpose Add RSSI calibration.

Format CUn

Range n = 0 (raw), n = 1 (calibrated)

Default CU1

Recommended Setting. The default setting for this command is recommended for most applications.

Description This command only affects calibrated ADCPs. It has no effect on un-calibrated ADCPs.

There is a blank line (<CR> <LF>) after the CU command entry and before the prompt (>).

CW – Select Dual Mode Data

Purpose Selects whether to tag the BroadBand or NarrowBand water ping data with the ID that the current TRDI software recognizes.

Format CWn

Range n = 0 (BroadBand), n = 1 (NarrowBand)

Default CW1

Recommended Setting. The default setting for this command is recommended for most applications.

Description The Ocean Surveyor/Observer has both NarrowBand and BroadBand water profiling modes. Each mode is assigned a unique ID value to allow the processing software to distinguish which mode is being used. TRDI's current software only decodes the BroadBand ID. This new command is a work around until the software can be updated to decode both modes.

For example, if only BroadBand pings were used, output the BroadBand fixed and variable leaders and the selected BroadBand ping data with the standard (BroadBand) ID. If only NarrowBand pings were used, output the NarrowBand fixed and variable leaders and the selected ping data with the standard ID.

If both BroadBand and NarrowBand pings were used, output the fixed and variable leaders for both bands, and the ping data for all selected types. The CWn command will select which ping type (BroadBand or NarrowBand) will get the standard band ID and the other ping type (BroadBand or NarrowBand) will get the standard ID plus one (see Figure 44 and Figure 45).

There is a blank line (<CR> <LF>) after the CW command entry and before the prompt (>).

CX – Trigger Input/Output

Purpose The Trigger Input allows the Ocean Surveyor to be pinged by an external +5V logic level signal.

Format CX*a*,*b*,*c*

Range *a* = 0 to 5
b = 0 to 5
c = 120 to 43200 seconds (0 = disable)

Default CX0,0,0

Recommended Setting. The default setting for this command is recommended for most applications.

Descriptions The minimum duration for the Trigger Input is 1 ms. The Input resistance is at least 2.7k Ohm. The Trigger Output is a +5V logic level signal as well. The nominal source resistance of the Trigger Output is 50 Ohms. The command that controls the Trigger Output and Input is CX*a*,*b*, where "*a*" controls the Trigger Input mode, and "*b*" the Trigger Output mode. For flexibility, several modes for the Trigger Input and Output operation have been implemented. See Table 32 for a description of the command.

The third parameter "c" is a timeout value in seconds.

Table 32: CX Command Description

Command	Action:	Description
CX 0,b	Trigger Input off	Normal Ocean Surveyor operating mode.
CX 1,b	Positive edge Trigger Input	Used if the Ocean Surveyor is to be Triggered by other equipment. One ping is executed on every rising edge of the Trigger signal. Care has to be taken by the user not to exceed the maximum allowable transmit duty cycle of 15%.
CX 2,b	Negative edge Trigger Input	Used if the Ocean Surveyor is to be Triggered by other equipment. One ping is executed on every falling edge of the Trigger signal. Care has to be taken by the user not to exceed the maximum allowable transmit duty cycle of 15%.
CX 3,b	Any edge Trigger Input	Used if the Ocean Surveyor is to be Triggered by other equipment. One ping is executed on every rising and falling edge of the Trigger signal. Care has to be taken by the user not to exceed the maximum allowable transmit duty cycle of 15%.
CX 4,b	High level Trigger Input	Used if the Ocean Surveyor is to be Triggered by other equipment. The Ocean Surveyor transmits pings as long as the positive level of the Trigger signal is present. In this way, a single ping or multiple pings can be transmitted depending on the duration of the positive level. Care has to be taken by the user not to exceed the maximum allowable transmit duty cycle of 15%. A time between pings has to be set for cases where multiple pings should be transmitted.
CX 5,b	Low level Trigger Input	Same as CX4,b except the Trigger is active at the low-level of the Trigger signal. Care has to be taken by the user not to exceed the maximum allowable transmit duty cycle of 15%. A time between pings has to be set for cases where multiple pings should be transmitted.
CX a,0	Trigger Output off	Normal Ocean Surveyor operating mode.
CX a,1	Trigger Output – XMT	The Trigger Output is at a high level during the time the Ocean Surveyor transmits.
CX a,2	Trigger Output – RCV	The Trigger Output is at a high level during the time the Ocean Surveyor receives.
CX a,3	Trigger Output – X/R	The Trigger Output is at a high level during the time the Ocean Surveyor transmits and receives.
CX a,4	Trigger Output – inverted X/R Trigger	Identical to CXa,3, except the signal is inverted. The Trigger Output is at a high level while the OS is not transmitting or receiving.

Environmental Commands

The ADCP uses the following commands to control the environmental and positional information that affects internal data processing.

Available Environmental Commands

This section lists the available Environmental commands.

```
>e?
Available Commands:

EA +00000 ----------------------- Heading Alignment (.01 deg cw)
EC 1500 ------------------------- Speed Of Sound (m/s)
ED 00000 ------------------------ Xdcr Depth(+)/Keel Offset(-) (dm)
EE 111110 ----------------------- Attitude Data Output and Interpolation
EF +001 ------------------------- External Pitch/Roll Factor
EH 00000,1 ---------------------- Heading {heading;frame}
EI +00000 ----------------------- Roll Misalignment Angle (.01 deg cw)
EJ +00000 ----------------------- Pitch Misalignment Angle (.01 deg cw)
EP +0000,+0000,1 ---------------- Tilts {pitch;roll;frame}
ER +0000 ------------------------ Roll (.01 deg cw)
ES 35 --------------------------- Salinity (ppt)
ET 2100 ------------------------- Water Temperature (.01 deg C)
EU 0 ---------------------------- Orientation [up=1, down=0]
EV +00000 ----------------------- Heading Bias (.01 deg cw)
EX 00000 ------------------------ Coordinate Transformations
EZ 10111010 --------------------- Sensor Source {c;d;h;p;r;s;t;u}
E? ------------------------------ Display E-Command Menu
```

Environmental Command Descriptions

EA - Heading Alignment

Purpose Corrects for physical heading-like misalignment between the projection of Beam 3 onto the ship's forward-starboard plane and the ship's forward axis.

Format EA±*nnnnn*

Range ±*nnnnn* = -17999 to 18000 hundredths of degrees

Default EA0

Recommended Setting. Set as needed.

Description EA is a heading-like alignment angle between the projection of the Y axis and the forward axis of the ship used in heading output and for transformation to earth coordinates. EA is a rotation about the mast (M) axis of the ship. It is defined as the heading of the Y instrument axis when the ship is level with ship heading zero. The Y instrument axis is the projection of beam 3 onto the instrument's X-Y plane. Use the EV-command to correct for heading bias (e.g., synchro/stepper signal bias, magnetic variation).

For systems that are fixed in place on a moving vessel and that have an external heading source or an internal heading source, use EA to set the amount of rotation that the Y axis is physically offset from the vessel's centerline (see Figure 41). For systems that are stationary and have an internal compass that are not on a moving platform, EA is typically set to zero, unless ship attitude output data is desired for other purposes (see EE - Attitude Data Output and Interpolation).

See the Installation Guide for a description of methods to calibrate EA after installation of an obliquely mounted ADCP (EI and EJ not zero).

Example The ADCP is mounted in place on a moving ship. The Y-axis has been rotated 45 clockwise (+45) from the ship's centerline. Use the EA command to tell the ADCP where the Y-axis is in relation to the ship's centerline. To convert +45 to an EA-command value, multiply the desired alignment angle in degrees by 100:

```
EA = +45.00 × 100 = +4500 = EA+04500
```

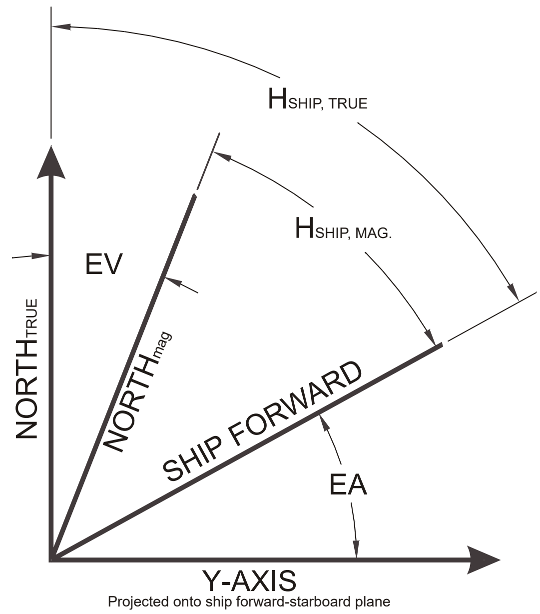


Figure 41. Y-axis Alignment

This view shows positive values for EV and EA.

If you are using the *VmDas* software, then this setting is performed in the same fashion from the Transforms tab. See the *VmDas* User's Guide for details.

EC - Speed of Sound

Purpose Sets the speed of sound value used for ADCP data processing.

Format EC*nnnn*

Range *nnnn* = 1400 to 1600 meters per second

Default EC1500

Recommended Setting. The default setting for this command is recommended for most applications.

Description EC sets the sound speed value used by the Ocean Surveyor ADCP to scale depth cell size, and range to the bottom. The ADCP assumes the speed of sound reading is taken at the transducer head. See the primer for information on speed of sound calculations.

If the EZ *Speed of Sound* field = 1, the ADCP overrides the manually-set EC value and calculates speed of sound using the values determined by transducer depth (ED), salinity (ES), and transducer temperature (ET). EZ also selects the source for ED, ES, and ET.

ED - Depth of Transducer

Purpose Sets the ADCP transducer depth.

Format ED*nnnnn*

Range *nnnnn* = 0 to 65535 decimeters (meters × 10)

Default ED00000

Recommended Setting. Set as needed.

Description ED sets the ADCP transducer depth. This measurement is taken from sea level to the transducer faces. The ADCP uses ED in its speed of sound calculations. The ADCP assumes the speed of sound reading is taken at the transducer head. See the primer for information on speed of sound calculations.

If the EZ *Transducer Depth* field = 1, the ADCP overrides the manually set ED value and uses depth from the depth sensor. If a depth sensor is not available, the ADCP uses the manual ED setting.

EE - Attitude Data Output and Interpolation

Purpose Specifies the coordinate frame used to reference the specialized attitude data types of Table 33.

Format EE *abcdef*

Range Firmware switches (see description)

Default EE111111

Recommended Setting. The default setting for this command is recommended for most applications.

Description Bits "a" and "b" are firmware switches that tell the ADCP what coordinate frame will be used to reference the heading, pitch and roll in the specialized attitude data type of Table 33.

Depending on the EE command bits "c" and "d" (see below), the attitude data will either be the pre-ping sample, an interpolation to the center of the profile for water track, an interpolation to the middle of the bottom echo or water mass layer. The attitude data at these times in addition to the attitude rates will be output for each of the selected ping types (bottom track, water mass or water profile) and in the specified coordinate system(s) if either of the first two EE bits is set.

The coordinate frames specified by bits "a" and "b" are as follows:

Table 33: Coordinate Frame

Ab	Coordinate Frame
00	No specialized attitude data type output
01	Instrument referenced data will be output

Ab	Coordinate Frame
10	Ship referenced data will be output
11	Both ship and instrument referenced data will be output

See Binary Variable Attitude Data Format for a complete description of the Binary Variable Attitude Output Data Format.

Bits "c" and "d" control the interpolation of attitude information that is used for earth velocity transformations. These bits have the following meaning:

Field	Value	Description
Water Profile		
c	0	Use pre-ping attitude sample only for water ping. Apply the same transformation to all bins. Similar to early TRDI firmware. The attitude data output by bits "a" and "b" will be the pre-ping sample.
c	1	Use a single interpolated attitude value based on pre and post ping sample corresponding to half the length of the profile for water profiling. The attitude data output by bits "a" and "b" will be this interpolated value.
c	2	Interpolate attitude across each bin of the profile using the pre and post ping samples of attitude. The attitude data output by bits a and b will be the value corresponding to the first bin of the profile. For the case of an even number of bins, the lower bin will be used.
Bottom Track or Water Mass		
d	0	Use pre-ping attitude sample only for each bottom and/or water mass ping. Similar to early TRDI firmware.
d	1	Use a single interpolated attitude value based on pre and post ping sample corresponding to the time when the transmit pulse is halfway across the bottom and/or water mass layer for bottom track and water mass layers, respectively.

Bit "e" controls the output of Attitude Command Parameters. Bit e = 1 causes this data type to be output. See Binary Fixed Attitude Data Format for a description of this data type.

Bit "f" controls the type of beam velocity data. Setting bit "f" set to 1 results in nominal 30° beam coordinate velocities output in the ensemble (later firmware will have the correction for autocorrelation peak movement and beam angle change with temperature). Setting Bit "f" to 0 results in raw beam velocities output in the ensemble.

EF - External Pitch/Roll Factor

Purpose Applies an integer factor to pitch and roll inputs.

Format EF±*nn*

Range *n* = -99 to 99

Default EF1

Recommended Setting. The default setting for this command is recommended for most applications.

Description The EF command applies an integer divisor or a multiplier to pitch and roll inputs received from an external synchro (e.g., EZxxx22xxx). For positive EF command inputs, a divisor is applied. For negative EF command inputs, a multiplier is applied. The range of divisors or multipliers is 1 to 99. When the EF-command is set to zero it forces pitch and roll to zero.

EH - Heading Angle

Purpose Sets the ADCP heading and the coordinate frame (instrument or ship) to which EH-command input refers.

Format EH±*xxxx*, *y*

Range ±*xxxx* = 00000 to 36000 hundredths of degrees

y = 0 for instrument coordinates

y = 1 for ship coordinates

Default EH0,0 (Stationary systems), EH0,1 (Vessel)

Recommended Setting. Set as needed.

Description EH sets the ADCP heading and heading coordinate frame if both arguments are entered.

EH sets the ADCP heading if only one argument is entered. This heading value is assumed to be in instrument coordinates.

Figure 42 shows transducer beam axes and tilt signs.

If the EZ *Heading* field = 1, the ADCP overrides the manually-set EH value and uses heading from the transducer's internal compass. If the EZ *Heading* field = 2, the ADCP takes heading from an external device. If EZ *Heading* field is 0, the ADCP uses the manual EH command settings.

See EZ - Sensor Source for more details and on restrictions for the case of mixed heading sources.

EI - Roll Misalignment Angle

Purpose Corrects for a physical roll-like misalignment between the x-axis of the instrument and the ship's starboard axis.

Format EI±*nnnnn*

Range ±*nnnnn* = -17999 to 18000 hundredths of degrees

Default EI0

Recommended Setting. Set as needed.

Description EI is a rotation about the ship's forward axis. It is defined as the roll of the ship when the instrument is level.

For systems that are fixed in place on a moving vessel and that have an external roll source or an internal roll source, use EI to set the amount of rotation that the instrument's x-axis is physically offset from the ship's starboard axis. Note that the EI command can also be used to align an upward pointing unit (for example, mounted on a submarine) to the ship's axis.

For systems that are stationary and have an internal compass, EI is typically set to zero since the velocity data is referenced to either beam, instrument or geographic coordinates instead of ship coordinates. However, a non-zero value may be used if ship attitude output data is desired for other purposes (see the EE command).

See the Installation Guide for a description of methods to calibrate EI after installation of the ADCP.

EJ - Pitch Misalignment Angle

Purpose Corrects for a physical pitch-like misalignment between the y-axis of the instrument and the ship's forward axis.

Format EJ±*nnnnn*

Range ±*nnnnn* = -17999 to 18000 hundredths of degrees

Default EJ0

Recommended Setting. Set as needed.

Description EJ is a rotation about the ship's starboard axis. It is defined as the roll of the ship when the instrument is level.

For systems that are fixed in place on a moving vessel and that have an external pitch source or an internal pitch source, use EJ to set the amount of rotation that the instrument's y-axis is physically offset from the ship's forward axis.

For systems that are stationary and have an internal compass, EJ is typically set to zero since the velocity data is referenced to either beam, instrument or geographic coordinates instead of ship coordinates. However, a non-zero value may be used if ship attitude output data is desired for other purposes (see the EE command).

See the Installation Guide for a description of methods to calibrate EJ after installation of the ADCP.

EP - Pitch and Roll Angles

Purpose Sets the ADCP pitch (tilt 1) and, optionally, the roll (tilt 2) and the coordinate frame (instrument or ship) to which EP-command pitch and roll inputs refer. Alternatively, the EP commands may be used with single arguments, in which case it is assumed that the pitch and roll inputs represent the pitch and roll of the instrument rather than those of the ship.

Format EP±*xxxx*, ±*yyyy*, *z*

Range ±*xxxx and* ±*yyyy* = -17999 to 18000 hundredths of degrees
z = 0 for instrument coordinates,
z = 1 for ship coordinates

Default EP0,0,0 (Stationary), EP0,0,1 (Vessel)

Recommended Setting. Set as needed.

Description EP sets the ADCP pitch (tilt 1) and roll (tilt 2) and the pitch/roll coordinate frame if all three arguments are entered.

EP sets the ADCP pitch (tilt 1) if only one argument is entered. This pitch value is assumed to be in instrument coordinates.

If only two fields are entered, a command entry error is issued.

Figure 42 shows transducer beam axes and tilt signs.

Example Convert pitch and roll values of +14 degrees and -3.5 degrees to EP-command values referenced to ship coordinates.

```
Pitch in hundredths = 14.00 × 100 = 1400
Roll in hundredths = -3.50 × 100 = -350

EP 1400, -350, 1            (+ in front of 1400 is optional)
```

If the EZ *Roll and Pitch* fields = 1, the ADCP overrides the manually-set EP value and uses roll from the transducer's internal tilt sensor. If the EZ *Roll and Pitch* fields = 2, the ADCP takes roll from an external synchro. If EZ *Roll and Pitch* fields are 0, the ADCP uses the manual EP command settings.

See EZ - Sensor Source for more details and on restrictions for the case of mixed pitch and roll sources.

ER - Roll (Tilt 2)

Purpose Sets the ADCP roll (tilt 2) angle.

Format ER±*nnnn*

Range ±*nnnn* = -6000 to 6000 (-60.00 to +60.00 degrees)

Recommended Setting. Set as needed.

Description ER sets the ADCP roll (tilt 2) angle.

Example Convert roll values of +14 and -3.5 to ER-command values.

```
ER = 14.00 × 100 = 1400 = ER01400 (+ is understood)
ER = -3.50 × 100 = -350 = ER-00350
```

If the EZ Roll field = one, the ADCP overrides the manually set ER value and uses roll from the transducer's internal tilt sensor. If the sensor is not available, the ADCP uses the manual ER setting.

The ER command is included for compatibility with existing software (see EP - Pitch and Roll Angles).

ES - Salinity

Purpose Sets the water's salinity value.

Format ES*nn*

Range *nn* = 0 to 50

Default ES35

Recommended Setting. The default setting for this command is recommended for most applications.

Description ES sets the water's salinity value. The ADCP uses ES in its speed of sound calculations. The ADCP assumes the speed of sound reading is taken at the transducer head.

ET - Temperature

Purpose Sets the water's temperature value.

Format ET±*nnnn*

Range ±*nnnn* = -500 C to +4000 hundredths of degrees C

Default ET2100

Recommended Setting. The default setting for this command is recommended for most applications.

Description ET sets the water's temperature value. The ADCP uses ET in its speed of sound calculations (see the primer). The ADCP assumes the speed of sound reading is taken at the transducer head.

Example Convert temperatures of +14 C and -3.5 C to ET-command values.

```
ET = 14.00 × 100 = 1400 = ET1400 (+ is understood)
ET = -3.50 × 100 = -350 = ET-0350
```

If the EZ *Temperature* field = 1, the ADCP overrides the manually-set ET value and uses temperature from the transducer's temperature sensor. If neither sensor is available, the ADCP uses the manual ET setting.

EU - Up/Down Orientation

Purpose Sets the ADCP up/down orientation.

Format EU*n*

Range *n* = 0 or 1 (0 = down, 1 = up)

Default EU0

Recommended Setting. Set as needed.

Description In conjunction with the EZ command, EU is used to manually specify the orientation of the ADCP.

EV - Heading Bias

Purpose Corrects for electrical/magnetic bias between the ADCP heading value and the heading reference.

Format EV±*nnnnn*

Range ±*nnnnn* = -17999 to 18000 hundredths of degrees

Default EV0

Recommended Setting. Set as needed.

Description EV is the heading angle that counteracts the electrical bias or magnetic variation (declination) between the ADCP and the heading source. Use the EA-command to correct for physical heading misalignment between the ADCP and a vessel's centerline.

For systems that are fixed in place on a moving vessel and that have an external heading source, use EV to set the amount of electrical bias between the vessel's heading source reading and the ADCP's output heading value.

For systems that are stationary and have an internal compass, use EV to counteract the effects of magnetic variation at the deployment site.

Example A bottom-mounted ADCP is receiving heading from its internal compass. A magnetic variation chart for the deployment area shows a variation of W3.5 (-3.5). To counteract the effects of this magnetic field, you must enter a heading bias value of -3.5. To convert -3.5 to an EV-command value, multiply the desired bias angle in degrees by 100: EV = -3.5 × 100 = -350 = EV-350.

In firmware version 14.09 and lower, the EB command was used in place of the EV command. If you are using command files created for these firmware versions, make sure you change the EB command to the new EV command.

If you are using the *VmDas* software, then this setting is performed in the same fashion from the Transforms tab. See the *VmDas* User's Guide for details.

EX - Coordinate Transformation

Purpose Sets the coordinate transformation processing flags.

Format EX*nnnnn*

Range Firmware switches (see Table 34)

Default EX00000

Recommended Setting. Set as needed.

Description EX sets firmware switches that control the coordinate transformation processing for velocity (see Binary Velocity Data Format) and percent-good output data.

Table 34: Coordinate Transformation Processing Flags

Bit Number	Description
EX00xxx	No transformation. Radial beam coordinates, i.e., 1, 2, 3, 4. Heading/Pitch/Roll not applied.
EX01xxx	Instrument coordinates. X, Y, Z components relative to the ADCP. Heading/Pitch/Roll not applied.
EX100xx	Unleveled Ship coordinates (Note 1) S, F, M components relative to the ship. Heading, pitch and roll not applied. EA, EI and EJ commands affect velocity rotations.
EX101xx	Leveled Ship coordinates (Note 1) S, F, M components relative to the projected ship's forward axis and the earth's horizontal plane. Heading not applied. Pitch and roll applied. The EA command always affects velocity rotations. The EI and EJ commands affect velocity rotations if either external pitch/roll sensors or external heading sensor is selected with the EZ or EP command.
EX110xx	Unleveled Earth coordinates (Note 1). Heading applied, but pitch and roll assumed zero for the raw sensor data, no matter whether referring to ship or instrument axes as selected by the EZ and EP command. The EA, EI and EJ commands always affects velocity rotations if either external sensors are selected with the EZ, EP or EH command.
EX111xx	Earth coordinates (Note 1) East, North, Vertical components relative to Earth East, North and Up components. Heading, pitch and roll applied for velocity rotations. EA, EI and EJ commands affect velocity rotations if external sensors are selected by the EZ, EP or EH command. Sometimes called geographic coordinates.
Exxx1xx	Use tilts (pitch and roll) in transformation
Exxxx1x	Allows 3-beam solutions if one beam is below the correlation threshold set by WC
Exxxxx1	Allow bin mapping (only performed for leveled ship and leveled earth transformations).

For ship and earth-coordinate transformations to work properly, you must set Heading, Pitch and Roll alignment (EA, EI and EJ) and Heading Bias (EV) correctly. You also must ensure that the tilt and heading sensors are active (EZ).

VmDas set the Ocean Surveyor ADCP to beam coordinates (EX00000).

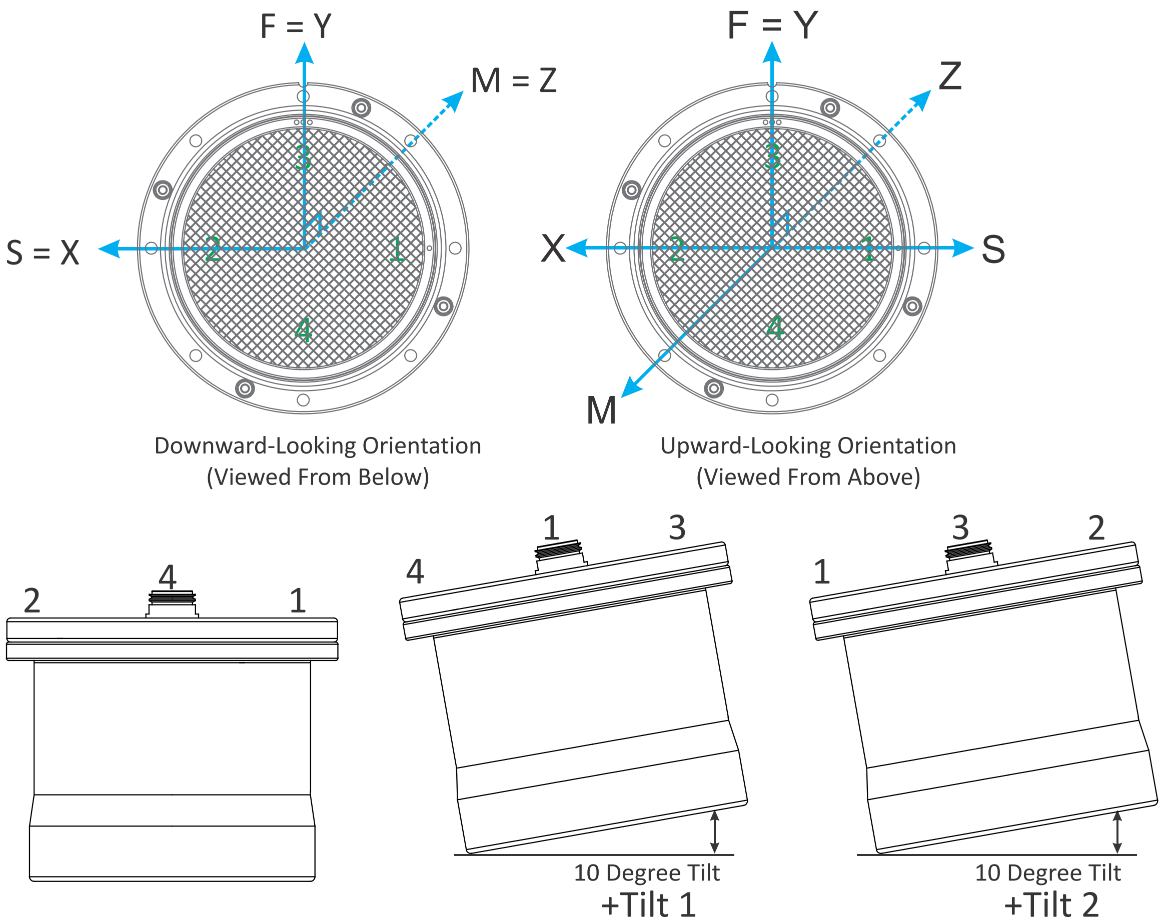


Figure 42. ADCP Coordinate Transformation

Depicted alignment of the ship and instrument axes is for the case **EA0**, **EJ0**. Up/Down orientation is specified by the **EI**, **EU** and **EZ** commands.

Downward:

1. EI0 when either up/down sensor indicates downward orientation
2. EU and EZ commands specify a downward looking instrument.

Upward:

1. EI180 when either up/down sensor indicates downward orientation
2. EU and EZ commands specify an upward looking instrument.

EZ - Sensor Source

Purpose Selects the source of environmental sensor data.

Format EZ*cdhprstu*

Range Firmware switches (see description)

Default EZ10111010

Recommended Setting. The default setting for this command is recommended for most applications.

Description Setting the EZ-command firmware switches tells the ADCP to use data from a manual setting or from an associated sensor. When a switch value is nonzero, the ADCP overrides the manual E-command setting and uses data from the appropriate sensor. If no sensor is available, the ADCP defaults to the manual E-command setting in instrument coordinates regardless of the coordinate frame parameter of the E-command setting.

Refer to Figure 43 for a description of how the EV and EA commands are used for internal and external heading sensors.

The following table shows how to interpret the sensor source switch settings.

Table 35: Sensor Source Switch Settings

FIELD		VALUE = 0	VALUE = 1	VALUE = 2
C	Speed of sound	Manual EC	Calculates using ED, ES, ET	Not Allowed
D	Depth	Manual ED	Not Allowed	Not Allowed
H	Heading	Manual EH	Internal transducer sensor	Not Allowed
P	Pitch (tilt 1)	Manual EP	Internal transducer sensor	Not Allowed
R	Roll (tilt 2)	Manual ER	Internal transducer sensor	Not Allowed
S	Salinity	Manual ES	Not Allowed	Not Allowed
T	Temperature	Manual ET	Internal transducer sensor	Not Allowed
U	Up/Down Orientation	Manual EU	Not Allowed	Not Allowed

Example EZ10122010 means calculate speed of sound from readings, use manual depth, transducer heading, external tilt sensors, manual salinity, transducer temperature, manual up/down orientation.

Note When you send a PS1-command, the displayed Fixed Leader data shows the available sensors connected to the ADCP. To interpret this PS1 field, convert the value to binary. Although you can enter a “2” (for external synchro) as part of the EZ-command string, the ADCP only displays zeroes and ones (0 = manual, 1 = either internal or external sensor) (see Binary Fixed Leader Data Format).

If EZ pitch is one (internal sensor), a pendulum pitch correction will be applied that removes the effect of roll on pitch. This effect is common to most tilt sensors (electrolytic tilt and pendulum).

The Pitch and Roll bits "p" and "r" must both reference the same coordinate system. The following table summarizes the valid EZ and EP inputs.

EZpr	EP Coordinate Frame	Comment
00	Ship or Instrument (EP X,X,X)	Allowed
01	Instrument (EP X,X,0)	Allowed

EZpr	EP Coordinate Frame	Comment
02	Ship (EP X,X,1)	Allowed
10	Instrument (EP X,X,0)	Allowed
10	Ship (EP X,X,1)	Not Allowed
11	Not Applicable	Allowed
12	Not Applicable	Not Allowed
20	Ship (EP X,X,1)	Allowed
20	Instrument (EP X,X,0)	Not Allowed
21	Not Applicable	Not Allowed
22	Not Applicable	Allowed

"X" in the above table is an arbitrary value.

When specifying hard-coded values (either EZpr bit 0), the EP command must be in the correct coordinate frame. To avoid conflicts when setting EZpr, these bits must set to non-zero values until the EP command has been entered with the coordinate frame that matches desired non-zero EZpr.

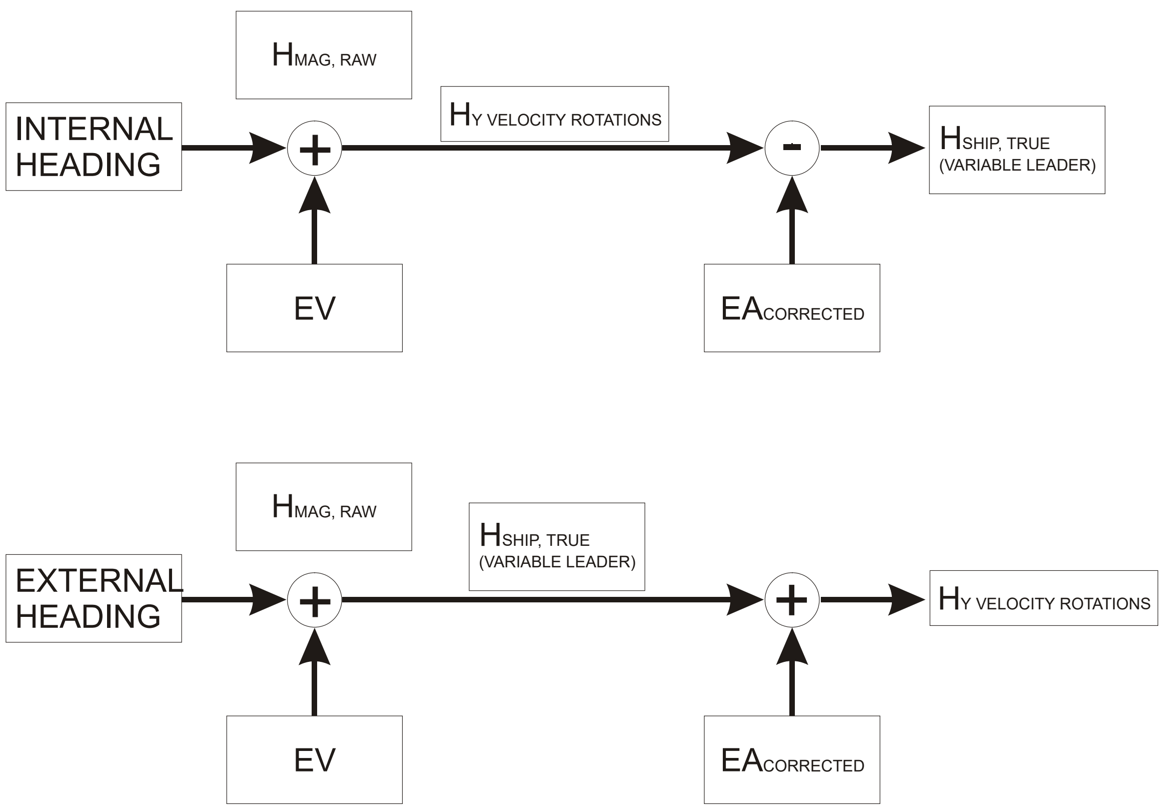


Figure 43. Heading Sensor Source and the Application of EV and EA

Fault Log Commands

The Ocean Surveyor uses the following commands to aid in troubleshooting and testing.

Available Fault Log Commands

This section lists the available Fault Log commands.

```
>l?
Available Commands:

LC ------------------------------ Clear Fault Log
LD ------------------------------ Display Fault Log
LL ------------------------------ Display Fault List
L? ------------------------------ Display L-Command Menu
```

Fault Log Command Descriptions

LC - Clear Fault Log

Purpose Clears the fault log.

Format LC

Description This commands removes all recorded faults from the fault log..

Recommended Setting. Use as needed.

Example

```
>LC
>LD  No faults recorded.
```

LD - Display Fault Log

Purpose Displays the fault log.

Format LD

Description This commands shows all faults recorded in the fault log. This may aid in troubleshooting.

Recommended Setting. Use as needed.

Example

```
>LD
Time of first fault:    2000/05/02,13:09:50
Overflow count:                   0

Fault Log:
     Code              Count            Time                Parameter
202   RTC POWER           1       2000/05/02,13:09:50       08410003h

End of fault log.
```

LL - Display Fault List

Purpose Lists possible faults.

Format LL

Description This command lists all fault conditions that are checked for by the ADCP.

Recommended Setting. Use as needed.

Example

```
>LL
Fault List:
Code    Fault
001     RESET
100     FPGA
201     RTC BATT LO
202     RTC POWER
203     RTC CAL
300     COM TIMEOUT
301     BUFFER OUT
400     RAM FAULT
401     ROM FAULT
402     MALLOC FAIL
500     GYRO COM
501     GYRO CKSUM
502     TCM2 COM
503     TCM2 CKSUM
504     TEMP INIT
505     TEMP READ
506     TEMP RANGE
600     SYS CONFIG
601     CMD PARAMS
602     COM PARAMS
```

Narrow Bandwidth Profiling Commands

The following commands define the criteria used to collect the Narrow Bandwidth water-profile data.

Available Narrow Bandwidth Profiling Commands

This section lists the available Narrow Bandwidth Profiling commands.

```
>n?
Available Commands:

NA 255 --------------------------- False Target Amplitude Threshold [0-255]
ND 111110000 -------------------- Data Out {v;c;a;p;s;*;*;*;*}
NE 1000 ------------------------- Error Velocity Threshold (mm/s)
NF 1600 ------------------------- Blanking Distance (cm)
NN 050 -------------------------- Number of Bins [0-128]
NP 000 -------------------------- Number of Pings
NS 3200 ------------------------- Bin Size (cm)
N? ------------------------------ Display N-Command Menu
```

Narrow Bandwidth Profiling Command Descriptions

NA – Narrow Bandwidth Profiling False Target Threshold

Purpose	Sets a false target (fish) filter
Format	NA*n*
Range	*n* = 0 to 255 counts
Default	NA255

Recommended Setting. The default setting for this command is recommended for most applications.

Description	The ADCP uses the NA-command to screen profile data for false targets (usually fish). NA sets the maximum difference between echo intensity readings among the four profiling beams. If the NA threshold value is exceeded, the ADCP rejects velocity data on a cell-by-cell basis for either the affected beam (fish detected in only one beam) or for the affected cell in all four beams (fish detected in more than one beam). This usually occurs when fish pass through one or more beams.
Notes	A NA value of 255 disables this feature. A typical setting is 55 to 75.

ND - Narrow Bandwidth Profiling Data Out

Purpose	Selects the type of data that is output by the ADCP		
Format	ND *abc def ghi*		
Range	*a* = 0 to 1	*d* = 0 to 1	*g* = 0 to 1
	b = 0 to 1	*e* = 0 to 1	*h* = 0 to 1
	c = 0 to 1	*f* = 0 to 1	*i* = 0 to 1
Default	ND111 110 000		

Recommended Setting. The default setting for this command is recommended for most applications.

Description	The ND selects the type of data that is output depending on the value in each field. Setting a bit to 1 enables the output while a 0 disables output. The fields listed below.

a = velocity	*d* = percent good	*g* = reserved
b = power	*e* = status	*h* = reserved
c = echo intensity	*f* = reserved	*i* = reserved

Notes	If NP = 0, then no narrowband profile data is output regardless of the ND setting.

NE - Narrow Bandwidth Profiling Error Velocity Threshold

Purpose	Sets the maximum error velocity for good profile data.
Format	NE*n*
Range	*n* = 0 to 9999 mm/s
Default	NE1000

Recommended Setting. The default setting for this command is recommended for most applications.

Description	NE sets a threshold value used to flag water-current data as good or bad. If the ADCP's error velocity value exceeds this threshold, it flags data as bad for a given depth cell. The NE-command screens for error velocities in both beam and transformed-coordinate data.

The default setting is set purposely high. We recommend extreme caution and testing before changing this setting. Data rejected by this command is lost and cannot be regained.

NF - Narrow Bandwidth Profiling Blank after Transmit

Purpose	Moves the location of first depth cell away from the transducer head to allow the transmit circuits time to recover before the receive cycle begins.
Format	NF*n*
Range	*n* = 20 to 9999 cm
Default	NF1600 (38kHz), NF800 (75kHz), NF400 (150kHz)

Recommended Setting. The default setting for this command is recommended for most applications.

Description	NF positions the start of the first depth cell at some vertical distance from the transducer head. This allows the ADCP transmit circuits time to recover before beginning the receive cycle. In effect, NF blanks out bad data close to the transducer head, thus creating a depth window that reduces unwanted data in the ensemble.

Small NF values may show ringing/recovery problems in the first depth cells that cannot be screened by the ADCP. We recommend you set NF to no less than the default value.

NN - Narrow Bandwidth Profiling Number of Profile Depth Cells

Purpose Sets the number of depth cells collected in each profile.

Format NN*nnn*

Range *nnn* = 1 to 128 depth cells

Default NN50

Recommended Setting. Set as needed.

Description The NN command sets the number of depth cells over which the ADCP collects data. The range of the profile is set by the number of depth cells (NN) times the size of each depth cell (NS).

NP - Narrow Bandwidth Profiling Pings Per Ensemble

Purpose Sets the number of narrowband profile pings to average together in each data ensemble.

Format NP*nnn*

Range *nnn* = 0 to 999 pings

Default NP0

Recommended Setting. Set as needed.

Description NP sets the number of narrowband profile pings to average together in each ensemble before sending profile data.

The ADCP interleaves profile pings with bottom-track pings (see TP - Time Between Pings).

If NP = zero, the ADCP does not collect narrowband profile data.

When using *VmDas*, the typical setup will use single ping (NP1) when doing Narrow Bandwidth profiling.

NS - Narrow Bandwidth Profiling Depth Cell Size

Purpose Selects the volume of water for one measurement cell.

Format NS*n*

Range *n* = 800 to 6400 cm for 38kHz systems.
n = 800 to 3200 cm for 75kHz systems.
n = 400 to 1600 cm for 150kHz systems.

Default NS3200 (38kHz), NS1600 (75kHz), NS800 (150kHz)

Recommended Setting. Set as needed.

Description NS Sets the size of depth cells over which the ADCP collects data. The range of the profile is set by the number of depth cells (NN) times the size of each depth cell (NS).

Performance and Testing Commands

The ADCP uses the following commands for calibration and testing.

Available Performance and Testing Commands

This section lists the available Performance and Testing commands.

```
>P?
Available Commands:

PA ------------------------------ Run all Built-In-Tests
PC ------------------------------ Display Sensor Data [0=help]
PD 0 ---------------------------- Data Stream Select
PS ------------------------------ System Info [0=config,1=fldr,2=vldr,4=pings]
PT ------------------------------ Diagnostic Tests [0=help]
P? ------------------------------ Display P-Command Menu
```

Performance and Testing Command Descriptions

PA - Built-In Tests

Purpose Sends and displays the results of a series of ADCP system diagnostic tests.

Format PA

Recommended Setting. Use as needed.

Description These diagnostic tests check the major ADCP modules and signal paths. We recommend you run this command before data collection.

Example See below.

```
>PA
RAM test...........PASS
ROM test...........PASS
Receive test.......PASS
Bandwidth test.....PASS
>
```

PC - Show Sensor Data

Purpose Displays output of various ADCP sensors.

Format PC*nnn*

Range *nnn* = 0, 2

Recommended Setting. Use as needed.

Description PC0 displays the help menu. PC2 shows sensor data for heading, pitch, roll, and temperature.

Examples See below.

Heading display is raw data from sensor and does not use any heading corrections. Heading source will correspond to source selected by the EZ-command.

```
>PC0
```

```
0=Help;2=Show Sensors
>PC2
Heading     Pitch      Roll        Temperature
 (int)      (int)      (int)       cts     degs
 000.0      +00.0      +00.0       0FF6    -36.3
 000.0      +00.0      +00.0       0FF5    -36.2
 000.0      +00.0      +00.0       0FF5    -36.2
 000.0      +00.0      +00.0       0FF5    -36.2
>
```

PD - Data Stream Select

Purpose Selects the type of ensemble output data structure.

Format PD*n*

Range *n* = 0

Default PD0

Recommended Setting. The default setting for this command is recommended for all applications.

Description The Ocean Surveyor currently supports only the PD0 output data structure.

PS - Display System Parameters

Purpose Displays ADCP system configuration data.

Format PS*n*

Range *n* = 0, 1, 2, 4

Recommended Setting. Use as needed.

Description See below.

PS0

PS0 displays system configuration info.

```
>PS0
       Frequency:  38400 HZ
   Configuration:  4 BEAM, JANUS
 Transducer Type:  ROUND 36x36
  Beamformer Rev:  A02 or later
      Beam Angle:  30 DEGREES
    Beam Pattern:  CONVEX
     Orientation:  DOWN
    CPU Firmware:  23.03
    FPGA Version:  XA
 Attitude Sensor:  SYNCHRO
```

PS1

PS1 displays the contents of the PD0 fixed leader (i.e., fixed system commands and hardware/firmware information) in Hex-ASCII or binary format with the Least Significant Byte (LSB) first. For example, a Hex-ASCII output may look like this:

```
>PS1
3300000E04490200000480010020003C80001001564000000000000000000005D1D06043603010100
002700000000000000000006003
>
```

PS2

PS2 displays the contents of the `PD0` variable leader (i.e., variable system commands and sensor readings) in Hex-ASCII or binary format with the Least Significant Byte (LSB) first. For example, a Hex-ASCII output may look like this:

```
>PS2
3D8000000045020D12222808000000A60500007D0EE8FEA9002300C8FF0000000000000000000000
000000000000000000000000000000000000000000724
>
```

PS4

PS4 displays the ping sequence.

```
>PS4
Ping Sequence:  BW
>
```

PT - Diagnostic Tests

Purpose	Displays results of the ADCP system diagnostic tests.
Format	PT*nnn*
Range	*n* = 0 to 200

Recommended Setting. Use as needed.

Description	See below

PT0 - Help

The `PT0` command will displays a test menu (shown below). As implied by the NOTE, adding 100 to the test number repeats the test continually until the ADCP receives a <BREAK>. Sending PT200 runs all tests except PT5.

```
>PT0
Built In Tests
----------------
 PT0 = Help
 PT1 = NA
 PT2 = NA
 PT3 = Receive Path Test
 PT4 = NA
 PT5 = Electronics Wrap Around Test
 PT6 = Receive Bandwidth Test
 PT7 = NA
 PT8 = NA
 PT9 = NA
NOTE: Add 100 for automatic test repeat
PT200 = All tests
```

PT3 - Receive Path Test

This test displays receive path characteristics.

```
>PT3
Correlation Magnitude:
      Lag     Bm1       Bm2       Bm3       Bm4
       0      1.00      1.00      1.00      1.00
       1      0.77      0.77      0.78      0.77
       2      0.34      0.34      0.35      0.32
       3      0.05      0.11      0.05      0.04
       4      0.09      0.16      0.09      0.10
       5      0.08      0.13      0.08      0.06
       6      0.03      0.09      0.02      0.02
       7      0.02      0.09      0.02      0.03

RSSI: 13 13 11 14

PASSED
>
```

The PT3 Test is considered to have normal values if the correlation values at lag 5 and greater are less than 0.50.

PT5 – Electronics Wrap Test

This test sets up the ADCP in a test configuration in which the test output lines from the timing generator circuit are routed directly to the receiver circuit. The receiver then processes this signal. The test output signal sends a certain correlation pattern when processed.

Place the transducer in water before running this test.

Do NOT ping the Ocean Surveyor/Observer with the transducer in air. The power assembly board will short, causing the electronics chassis to no longer communicate. The transducer is pinged by sending a CS or PT5 command or if *VmDas* is started for collecting data – either of these methods will cause damage if the transducer is in air.

This is an example of a transducer problem, based on the low 'Amplitude Data' in the PT5 test results:

```
Correlation Data:                  Amplitude Data:
Bin  0:   78  116    8   56       13   25   20   26
Bin  1:   44   47   12   58        2    7    2    6
Bin  2:   44   70   82   80        1    2    0    1
Bin  3:   27   36    0   27        1    8    2    1
Bin  4:   35    8   44    8        1    4    1    1
Bin  5:   70   44   66   19        6    3    1    4
Bin  6:   63    8   51   37        7    3    1    3
Bin  7:   35  123   39   96        4    2    1    3
Bin  8:  113   70   74   47        1    2    0    1
Bin  9:   51   19   39   19        1    3    3    2
Bin 10:   35   53    0   27        1    2    0    4
Bin 11:  103   80   17   31
```

The system needs better amplitude to be able to decode the expected Correlation pattern in the bin data. Here is the PT5 test from a working system:

```
Correlation Data:                Amplitude Data:
Bin  0:    0    0    0    0        4   10    4   11
Bin  1:    0    0    0    0      196  198  196  195
Bin  2:    0    0    0    0      194  199  197  193
Bin  3:    0    0    0    0      195  199  197  195
Bin  4:  254  254  254  254      195  198  196  195
Bin  5:    0    0    0    0      194  199  197  193
Bin  6:    0    0    0    0      195  198  196  195
Bin  7:  254  254  254  254      195  198  196  195
Bin  8:    0    0    0    0      194  199  197  194
Bin  9:    0    0    0    0      195  198  196  195
Bin 10:    0    0    0    0      194  199  197  193
Bin 11:  254  254  254  254
>
```

Note the difference in 'Amplitude'. When the system receives good amplitude, it can decode the transmitted pattern of low and high Correlation in the 'Bin' data.

The most likely cause of low Amplitude Data is shorting of the ceramic array in the transducer. Other possible causes include a broken beamformer, a transducer I/O cable or bulkhead connector fault, or a broken high power amp in the chassis.

PT6 - Receive Bandwidth Test

This test measures the receive bandwidth of the system.

```
>PT6
Receive Bandwidth:
........................................
  Expected      Bm1    Bm2    Bm3    Bm4
  --------     -----  -----  -----  -----
   15500       14432  14498  15752  15406

PASSED

>
```

The PT6 Test is considered to have normal values if the received bandwidth for each beam is within ± 20% of the expected bandwidth.

Timing Commands

The following commands let you set the timing of various profiling functions.

Available Timing Commands

This section lists the available Timing commands.

```
>t?
Available Commands:

TC ------------------------------ System Timer Value
TE 00:00:00.00 ------------------ Time Between Ensembles
TP 00:03.00 --------------------- Time Between Pings
TS 06/04/12,11:13:48.29 --------- Set System Date and Time
T? ------------------------------ Display T-Command Menu
```

Timing Command Descriptions

TC - System Timer Value

Purpose Outputs the system timer raw value.

Format TC

Description For TRDI use only.

TE - Time Per Ensemble

Purpose Sets the minimum interval between data collection cycles (data ensembles).

Format TE*hhmmssff*

Default TE00:00:00.00

Recommended Setting. The default setting for this command is recommended for most applications.

Range *hh* = 00 to 23 hours
mm = 00 to 59 minutes
ss = 00 to 59 seconds
ff = 00 to 99 hundredths of seconds

Description During the ensemble interval set by TE, the ADCP transmits the number of pings set by the WP, NP, and BP commands. If TE = 0, the ADCP starts collecting the next ensemble immediately after processing the previous ensemble.

Example TE01153000 tells the ADCP to collect data ensembles every 1 hour, 15 minutes, 30 seconds.

The ADCP automatically increases TE if ((WP + NP + BP) x TP > TE).

The time tag for each ensemble is the time of the first ping of that ensemble, not the time of output.

TP - Time Between Pings

Purpose Sets the *minimum* time between pings.

Format TP*mm:ss.ff*

Range *mm* = 00 to 59 minutes
ss = 00 to 59 seconds
ff = 00 to 99 hundredths of seconds

Default TP000300 (38kHz), TP000200 (75kHz), TP000100 (150kHz)

Recommended Setting. The default setting for this command is recommended for most applications.

Description The ADCP interleaves individual pings within a group so they are evenly spread throughout the ensemble. During the ensemble interval set by TE, the ADCP transmits the number of pings set by the WP,NP, and BP commands. TP determines the spacing between the pings. If TP = 0, the ADCP pings as quickly as it can based on the time it takes to transmit each ping plus the overhead that occurs for processing.

Example TP00:00.10 sets the time between pings to 0.10 second.

The ADCP automatically increases TE if ((WP + NP + BP) x TP > TE).

TS - Set System Date and Time

Purpose Sets the ADCP's internal clock.

Format TS*yymmddhhmmss*

Range *yy* = year 00-99
mm = month 01-12
dd = day 01-31
hh = hours 00-23
mm = minutes 00-59
ss = seconds 0-59

Description When the ADCP receives the carriage return after the TS-command, it enters the new time into the clock and sets hundredths of seconds to zero. The clock will continue to function through and after the transition from 2359 31DEC1999 to 0000 1JAN2000. The clock is also aware of leap years and the fact that 2000 is a leap year.

Example TS000617131500 sets the clock to 1:15:00 pm, June 17, 2000.

Broad Bandwidth Water-Profiling Commands

The following commands define the criteria used to collect the Broad Bandwidth (or Wide Bandwidth) water-profile data.

Available Broad Bandwidth Water-Profiling Commands

This section lists the available Broad Bandwidth Water-Profiling commands.

```
>w?
Available Commands:

WA 255 -------------------------- False Target Amplitude Threshold [0-255]
WC 120 -------------------------- Correlation Threshold [0-255]
WD 111110000 -------------------- Data Out {v;c;a;p;s;*;*;*;*}
WE 1000 ------------------------- Error Velocity Threshold (mm/s)
WF 1600 ------------------------- Blanking Distance (cm)
WN 050 -------------------------- Number of Bins [0-128]
WP 001 -------------------------- Number of Pings
WS 3200 ------------------------- Bin Size (cm)
WV 0390 ------------------------- Ambiguity Velocity (cm/s)
W? ------------------------------ Display W-Command Menu
```

Broad Bandwidth Water-Profiling Command Descriptions

WA – Broad Bandwidth Profiling False Target Threshold

Purpose	Sets a false target (fish) filter
Format	WA*n*
Range	*n* = 0 to 255 counts
Default	WA255

Recommended Setting. The default setting for this command is recommended for most applications.

Description: The ADCP uses the WA-command to screen profile data for false targets (usually fish). WA sets the maximum difference between echo intensity readings among the four profiling beams. If the WA threshold value is exceeded, the ADCP rejects velocity data on a cell-by-cell basis for either the affected beam (fish detected in only one beam) or for the affected cell in all four beams (fish detected in more than one beam). This usually occurs when fish pass through one or more beams.

A WA value of 255 disables this feature. A typical setting is 55 to 75.

WC - Broad Bandwidth Profiling Water Correlation Threshold

Purpose	Sets the minimum correlation for valid velocity data.
Format	WC*nnn*
Range	*nnn* = 0 to 255 counts
Default	WC120

Recommended Setting. The default setting for this command is recommended for most applications.

Description: The ADCP uses WC to screen water-track data for the minimum acceptable correlation requirements. WC sets the threshold of this correlation below which the ADCP flags the data as bad.

The default threshold for all Ocean Surveyor frequencies is 120 counts. A solid target would have a correlation of 255 counts.

WD - Broad Bandwidth Profiling Data Out

Purpose	Selects the data types collected by the ADCP.
Format	WD *abc def ghi*
Range	*a* = 0 to 1, *b* = 0 to 1, *c* = 0 to 1, *d* = 0 to 1, *e* = 0 to 1, *f* = 0, *g* = 0, *h* = 0, *i* = 0
Default	WD111 110 000

Recommended Setting. The default setting for this command is recommended for most applications.

Description: The WD command uses firmware switches to tell the ADCP the types of data to collect. The ADCP always collects header data, fixed/variable leader data, and checksum data. Setting a bit to 1 tells the ADCP to collect that data type. The bits are described as follows:

a = velocity	*d* = percent good	*g* = reserved
b = power	*e* = status	*h* = reserved
c = echo intensity	*f* = reserved	*i* = reserved

Example: WD 111 110 000 (default) tells the ADCP to collect velocity, correlation magnitude, echo intensity, percent good, and status.

Each bit can have a value of one or zero: one means output data; zero means suppress data.

If WP = 0, the ADCP does not collect water-track data.

Spaces in the command line are allowed.

WE - Broad Bandwidth Profiling Error Velocity Threshold

Purpose Sets the maximum error velocity for good profile data.

Format WE*nnnn*

Range *n* = 0 to 9999 mm/s

Default WE1000

Recommended Setting. The default setting for this command is recommended for most applications.

Description The WE-command sets a threshold value used to flag water-current data as good or bad. If the ADCP's error velocity value exceeds this threshold, it flags data as bad for a given depth cell. The WE-command screens for error velocities in both beam and transformed-coordinate data.

The default setting is set purposely high. We recommend extreme caution and testing before changing this setting. Data rejected by this command is lost and cannot be regained.

WF - Broad Bandwidth Profiling Blank after Transmit

Purpose Moves the location of first depth cell away from the transducer head to allow the transmit circuits time to recover before the receive cycle begins.

Format WF*nnnn*

Range *nnnn* = 20 to 9999 cm (328 feet)

Default WF1600 (38kHz), WF800 (75kHz), WF400 (150kHz)

Recommended Setting. The default setting for this command is recommended for most applications.

Description WF positions the start of the first depth cell at some vertical distance from the transducer head. This allows the ADCP transmit circuits time to recover before beginning the receive cycle. In effect, WF blanks out bad data close to the transducer head, thus creating a depth window that reduces unwanted data in the ensemble.

Small WF values may show ringing/recovery problems in the first depth cells that cannot be screened by the ADCP. We recommend you set WF to no less than the default value.

WN - Broad Bandwidth Profiling Number of Depth Cells

Purpose Sets the number of depth cells over which the ADCP collects data.

Format WN*nnn*

Range *nnn* = 0 to 128 depth cells

Default WN50

Recommended Setting. Set as needed.

Description The range of the ADCP is set by the number of depth cells (WN) times the size of each depth cell (WS).

WP - Broad Bandwidth Profiling Pings per Ensemble

Purpose Sets the number of broadband profile pings to average together in each data ensemble.

Format WP*nnn*

Range *nnn* = 0 to 999 pings

Default WP1

Recommended Setting. The default setting for this command is recommended for most applications.

Description WP sets the number of broadband profile pings to average together in each ensemble before sending profile data.

The ADCP interleaves profile pings with bottom-track pings (see TP - Time Between Pings).

If WP = zero, the ADCP does not collect broadband profile data.

When using *VmDas*, the typical setup will use single ping (WP1) when doing Broad Bandwidth profiling.

WS - Broad Bandwidth Profiling Depth Cell Size

Purpose Selects the volume of water for one measurement cell.

Format WS*nnnn*

Range *n* = 400 to 6400 cm for 38kHz systems.
n = 200 to 3200 cm for 75kHz systems.
n = 100 to 1600 cm for 150kHz systems.

Default WS3200 (38kHz), WS1600 (75kHz), WS800 (150kHz)

Recommended Setting. The default setting for this command is recommended for most applications.

Description WN Sets the size of depth cells over which the ADCP collects data. The range of the profile is set by the number of depth cells (WN) times the size of each depth cell (WS).

WV - Broad Bandwidth Profiling Ambiguity Velocity

Purpose Sets the radial ambiguity velocity for broadband profiling.

Format WV*nnn*

Range *nnn* = 0 to 9999 cm/s

Default WV390

Recommended Setting. The default setting for this command is recommended for most applications.

Description WV sets the radial ambiguity velocity for broadband profiling. Velocities above this value may cause ambiguity errors.

It is strongly recommended that the WV command be left at its' default value of 390.

Narrow Bandwidth Mode Ambiguity

With the default setup, the beam-radial ambiguity velocity Ua is 450 cm/s. The formula for calculating the max speed in Narrow Bandwidth mode is:

NBmax = Ua / sin(beam angle) / cos(rotation angle)

For a 45-degree rotation, this gives a max horizontal speed of 12.7 m/s or about 25 knots.

Broad Bandwidth Mode Ambiguity

The maximum WV setting is 390 cm/s. This is because the PA transducer cannot produce a bandwidth wider than that to support larger ambiguity settings (smaller lags than 390 cm/s). Therefore, we have added the capability to offset the ambiguity lane. The equation for calculating the max speed in Broad Bandwidth mode is:

BBmax = (Ua + offset) / sin(beam angle) / cos(rotation angle)

The default offset values (&W+00,+00,+195,-195) assume that beam 3 is forward and have values of:

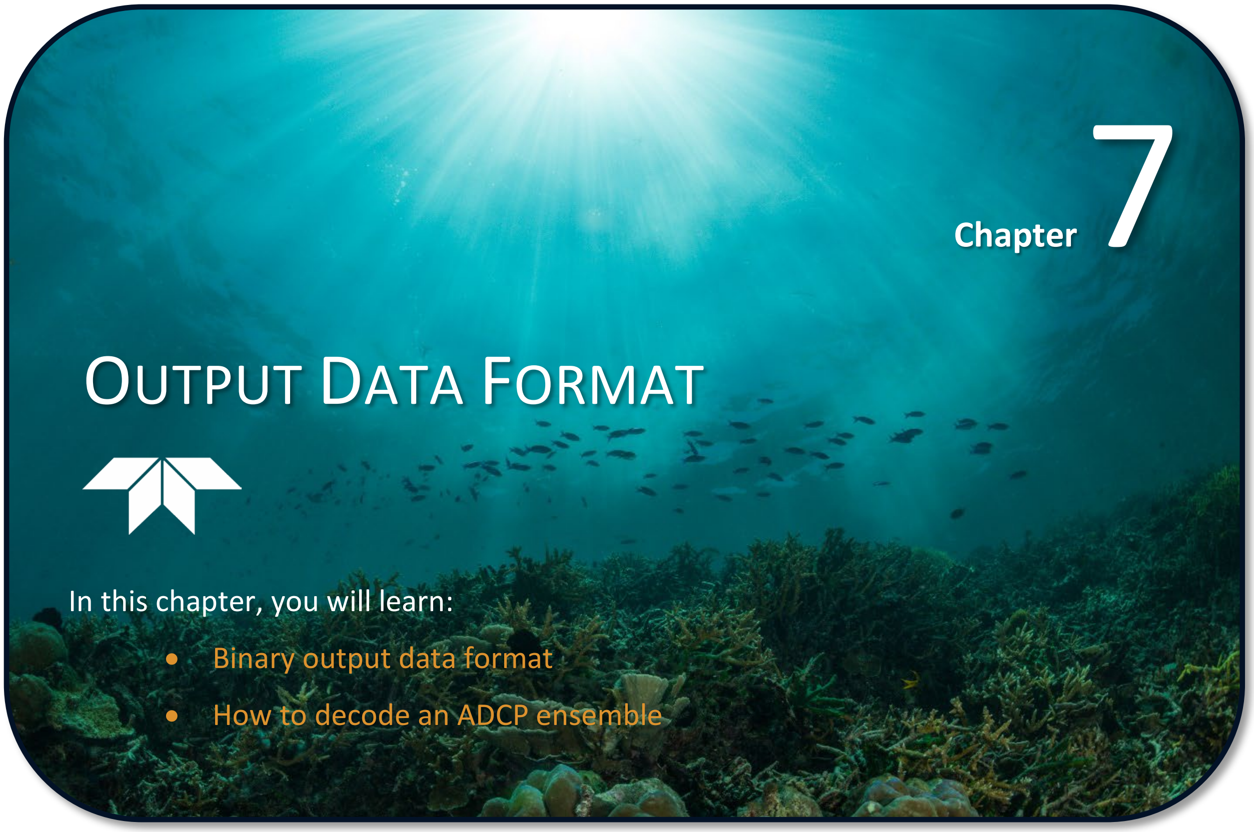
beam 1: 0
beam 2: 0
beam 3: +195 cm/s
beam 4: -195 cm/s

Consequently, the default max speed in Broad Bandwidth mode for a 45-degree rotation is:

beam 1: -11 m/s to + 11 m/s
beam 2: -11 m/s to + 11 m/s
beam 3: -5.5 m/s to + 16.5 m/s
beam 4: -5.5 m/s to + 16.5 m/s

Which means the maximum speed is effectively 11 ms/ (22 knots). You can raise the maximum speed to 16.5 m/s (33 knots) by setting the ambiguity offset with &W +195,-195,+195,-195.

> If you set WV above 390, the system will still use 390 because it will not use a shorter lag. No errors will occur by using higher values of WV390.



Chapter 7

OUTPUT DATA FORMAT

In this chapter, you will learn:

- Binary output data format
- How to decode an ADCP ensemble

Binary Output and VmDas

This section shows the format of the VmDas Short Term Average (STA) and Long Term Average (LTA) files when using an Ocean Surveyor ADCP (firmware version 23.xx and higher). The VmDas STA and LTA output can only be binary. We explain the output data formats in enough detail to let you create your own data processing or analysis programs.

This guide applies to Ocean Surveyor firmware version 23.19. When new firmware versions are released, some output data formats may be modified or added. Read the README file on the upgrade disk, or check TRDI's web site for the latest changes.

The Ocean Surveyor binary output data buffer contains header data, leader data, velocity, correlation magnitude, echo intensity, percent good, and a checksum. The Ocean Surveyor collects all data in the output buffer during an ensemble. The *VmDas* program writes this Ocean Surveyor output into the *.ENR files and then inserts the navigation data before the checksum (and reserved bytes) when it saves the *.STA and *.LTA files.

Figure 44 and Figure 45 shows the format of this buffer and the sequence in which the VmDas program creates the *.STA and *.LTA files. Figure 46 through Figure 56 show the format of the individual items that make up the binary output buffer. Table 37 through Table 51 lists the format, bytes, fields, scaling factors, and a detailed description of every item in the binary output buffer.

Binary Standard Output Data Buffer Format

Always Output	**HEADER** (6 BYTES + [2 x No. OF DATA TYPES])
	FIXED LEADER DATA (50 BYTES)
	VARIABLE LEADER DATA (60 BYTES)
WD **or** ND command WP **or** NP command	**VELOCITY** (2 BYTES + 8 BYTES PER DEPTH CELL)
	CORRELATION MAGNITUDE (2 BYTES + 4 BYTES PER DEPTH CELL)
	ECHO INTENSITY (2 BYTES + 4 BYTES PER DEPTH CELL)
	PERCENT GOOD (2 BYTES + 4 BYTES PER DEPTH CELL)
	STATUS (2 BYTES + 4 BYTES PER DEPTH CELL)
BP command	**BOTTOM-TRACK** (81 BYTES)
	FIXED ATTITUDE (41 BYTES)
	VARIABLE ATTITUDE (12 BYTES PER DATA TYPE)
	NAVIGATION (78 BYTES) (*VmDas* ENS, ENX, STA, and LTA files only)
Always Output	**RESERVED** (2 BYTES)
	CHECKSUM (2 BYTES)

Figure 44. Binary Standard Output Data Buffer Format (WP or NP Command)

Figure 44 shows the binary output data buffer format when WP > zero or NP > zero (one or the other, not both). See Figure 45 for the output buffer when both WP and NP > zero.

Some data outputs are in bytes per depth cell. For example, if the WN-command (number of depth cells) = 23, and the following data are selected for output, the required data buffer storage space is 780 bytes per ensemble:

WD-Command =WD 111 100 000 (default), WP-Command = zero, BP-Command > zero, NP-Command > zero, EE-Command = EE11111100 (Default)

```
 50   Bytes of Header Data (6+2x8)
 60   Bytes of Fixed Leader Data (fixed)
 42   Bytes of Variable Leader Data (fixed)
 186  Bytes of Velocity Data (2+8x23)
 94   Bytes of Correlation Magnitude Data (2+4x23)
 94   Bytes of Echo Intensity (2+4x23)
 81   Bytes of Bottom Track Data (fixed)
 43   Bytes of Fixed Attitude Data (fixed)
 50   Bytes of Variable Attitude Data (2+4x12)
 78   Bytes of Navigation Data (fixed)
 2    Bytes of Reserved for TRDI Use (fixed)
 2    Bytes of Checksum Data (fixed)
--------------------------------------------------
 782  Bytes of data per ensemble
```

Always Output	**HEADER** (6 BYTES + [2 x No. OF DATA TYPES])
	FIXED LEADER DATA (50 BYTES)
	VARIABLE LEADER DATA (60 BYTES)
WD command WP command	**VELOCITY** (2 BYTES + 8 BYTES PER DEPTH CELL)
	CORRELATION MAGNITUDE (2 BYTES + 4 BYTES PER DEPTH CELL)
	ECHO INTENSITY (2 BYTES + 4 BYTES PER DEPTH CELL)
	PERCENT GOOD (2 BYTES + 4 BYTES PER DEPTH CELL)
	STATUS (2 BYTES + 4 BYTES PER DEPTH CELL)
BP command	**BOTTOM-TRACK** (81 BYTES)
	FIXED LEADER DATA (50 BYTES)
	VARIABLE LEADER DATA (60 BYTES)
ND command NP command	**VELOCITY** (2 BYTES + 8 BYTES PER DEPTH CELL)
	CORRELATION MAGNITUDE (2 BYTES + 4 BYTES PER DEPTH CELL)
	ECHO INTENSITY (2 BYTES + 4 BYTES PER DEPTH CELL)
	PERCENT GOOD (2 BYTES + 4 BYTES PER DEPTH CELL)
	STATUS (2 BYTES + 4 BYTES PER DEPTH CELL)
BP command	**BOTTOM-TRACK** (81 BYTES)
	FIXED ATTITUDE (41 BYTES)
	VARIABLE ATTITUDE (12 BYTES PER DATA TYPE)
	NAVIGATION (78 BYTES) (*VmDas* ENS, ENX, STA, and LTA files only)
Always Output	**RESERVED** (2 BYTES)
	CHECKSUM (2 BYTES)

Figure 45. Binary Standard Output Data Buffer Format (WP and NP Command)

Table 36: Standard or Standard Plus 1 Data Format IDs

Standard ID		Standard plus 1 ID		Description
MSB	LSB	MSB	LSB	
7F	7F	7F	7F	Header
00	00	00	01	Fixed Leader
00	80	00	81	Variable Leader
01	00	01	01	Velocity Profile Data
02	00	02	01	Correlation Profile Data
03	00	03	01	Echo Intensity Profile Data
04	00	04	01	Percent Good Profile Data
05	00	05	01	Status Profile Data
06	00	06	01	Bottom Track Data
20	00	20	00	Navigation
30	00	30	00	Binary Fixed Attitude
30	40 - F0	30	40 – F0	Binary Variable Attitude

The CW command selects which ping type (BroadBand or NarrowBand) will get the standard ID and the other ping type (BroadBand or NarrowBand) will get the standard plus one ID (see CW – Select Dual Mode Data).

The ADCP always sends the Least Significant Byte (LSB) first.

PDDecoder Library in C language

The Teledyne Marine PDDecoder library is an open source library written in C language to decode the PD0 data formats that are commonly output by Teledyne Marine/Teledyne RD Instruments ADCPs.

Available for download from the Teledyne Marine software portal:
https://tm-portal.force.com/TMsoftwareportal

Binary Header Data Format

BYTE	7	6	5	4	3	2	1	0	
	BIT POSITIONS								
1	HEADER ID (7Fh)								
2	DATA SOURCE ID (7Fh)								
3	NUMBER OF BYTES IN ENSEMBLE								LSB
4									MSB
5	SPARE								
6	NUMBER OF DATA TYPES								
7	OFFSET FOR DATA TYPE #1								LSB
8									MSB
9	OFFSET FOR DATA TYPE #2								LSB
10									MSB
11	OFFSET FOR DATA TYPE #3								LSB
12									MSB
↓	(SEQUENCE CONTINUES FOR UP TO N DATA TYPES)								↓
2N+5	OFFSET FOR DATA TYPE #N								LSB
2N+6									MSB

Figure 46. Binary Header Data Format

Header information is the first item sent by the ADCP to the output buffer. The ADCP always sends the Least Significant Byte (LSB) first.

Table 37: Binary Header Data Format

Hex Digit	Binary Byte	Field	Description
1,2	1	HDR ID / Header ID	Stores the header identification byte (7Fh).
3,4	2	HDR ID / Data Source ID	Stores the data source identification byte (7Fh for the ADCP).
5-8	3,4	Bytes / Number of bytes in ensemble	This field contains the number of bytes from the start of the current ensemble up to, but not including, the 2-byte checksum.
9,10	5	Spare	Undefined.
11,12	6	No. DT / Number of Data Types	This field contains the number of data types selected for collection. By default, fixed/variable leader, velocity, correlation magnitude, echo intensity, and percent-good are selected for collection. This field will therefore have a default value of six (4 data types + 2 for the Fixed/Variable Leader data).
13-16	7,8	Address Offset for Data Type #1 / Offset for Data Type #1	This field contains the internal memory address offset where the ADCP will store information for data type #1 (with this firmware, always the Fixed Leader). Adding "1" to this offset number gives the absolute Binary Byte number in the ensemble where Data Type #1 begins (the first byte of the ensemble is Binary Byte #1).
17-20	9,10	Address Offset for Data Type #2 / Offset for Data Type #2	This field contains the internal memory address offset where the ADCP will store information for data type #2 (with this firmware, always the Variable Leader). Adding "1" to this offset number gives the absolute Binary Byte number in the ensemble where Data Type #2 begins (the first byte of the ensemble is Binary Byte #1).
21-24 thru 2n+13 to 2n+16	11,12 thru 2n+5, 2n+6	Address Offsets for Data Types #3-n / Offset for Data Type #3 through #n	These fields contain internal memory address offset where the ADCP will store information for data type #3 through data type #n. Adding "1" to this offset number gives the absolute Binary Byte number in the ensemble where Data Types #3-n begin (first byte of ensemble is Binary Byte) #1).

Binary Fixed Leader Data Format

BYTE	BIT POSITIONS 7	6	5	4	3	2	1	0	
1	FIXED LEADER ID 0000 or 0001							00h or 01h	LSB
2								00h	MSB
3	CPU F/W VER.								
4	CPU F/W REV.								
5	SYSTEM CONFIGURATION								LSB
6									MSB
7	RESERVED								
8									
9	NUMBER OF BEAMS								
10	NUMBER OF CELLS {WN}								
11	NUMBER OF PINGS								LSB
12									MSB
13	DEPTH CELL LENGTH {WS}								LSB
14									MSB
15	BLANK AFTER TRANSMIT {WF}								LSB
16									MSB
17	SIGNAL PROCESSING MODE								
18	BROAD BANDWIDTH PROFILING WATER CORRELATION THRESHOLD								
19	NUMBER CODE REPS								

Continued Next Page

Continued From Previous Page

BYTE	BIT POSITIONS 7 6 5 4 3 2 1 0	
20	PERCENT GOOD MINIMUM {WG}	
21 22	ERROR VELOCITY MAXIMUM {WE}	
23	TPP MINUTES	
24	TPP SECONDS	
25	TPP HUNDREDTHS {TP}	
26	COORDINATE TRANSFORMATION {EX}	
27 28	HEADING ALIGNMENT {EA}	LSB MSB
29 30	HEADING BIAS {EB}	LSB MSB
31	SENSOR SOURCE {EZ}	
32	SENSORS AVAIL	
33 34	BIN 1 DISTANCE	LSB MSB
35 36	XMIT PULSE LENGTH BASED ON {WT}	LSB MSB
37 38	RESERVED	
39	FALSE TARGET THRESH {WA}	
40	RESERVED	
41 42	TRANSMIT LAG DISTANCE	LSB MSB
43 ↓ 50	RESERVED	↓

Figure 47. Binary Fixed Leader Data Format

Fixed Leader data refers to the non-dynamic ADCP data that only changes when you change certain commands. Fixed Leader data also contain hardware information. The ADCP always sends Fixed Leader data as output data (LSBs first). See Command Descriptions for detailed descriptions of commands used to set these values.

Table 38: Binary Fixed Leader Data Format

Hex Digit	Binary Byte	Field	Description
1-4	1,2	FID / Fixed Leader ID	Stores the Fixed Leader identification word 0000 or 0001 (see CW – Select Dual Mode Data). LSB is sent first.
5,6	3	fv / CPU F/W Ver.	Contains the version number of the CPU firmware.
7,8	4	fr / CPU F/W Rev.	Contains the revision number of the CPU firmware.
9-12	5,6	Sys Cfg / System Configuration	This field defines the ADCP hardware configuration. Convert this field (2 bytes, LSB first) to binary and interpret as follows. LSB BITS 7 6 5 4 3 2 1 0 - - - - - 0 0 0 75-kHz SYSTEM - - - - - 0 0 1 150-kHz SYSTEM - - - - - 0 1 0 300-kHz SYSTEM - - - - - 0 1 1 600-kHz SYSTEM - - - - - 1 0 0 1200-kHz SYSTEM - - - - - 1 0 1 2400-kHz SYSTEM - - - - - 1 1 0 38-kHz SYSTEM - - - - 0 - - - CONCAVE BEAM PAT. - - - - 1 - - - CONVEX BEAM PAT. - - 0 0 - - - - SENSOR CONFIG #1 - - 0 1 - - - - SENSOR CONFIG #2 - - 1 0 - - - - SENSOR CONFIG #3 - 0 - - - - - - XDCR HD NOT ATT. - 1 - - - - - - XDCR HD ATTACHED 0 - - - - - - - DOWN FACING BEAM 1 - - - - - - - UP-FACING BEAM MSB BITS 7 6 5 4 3 2 1 0 - - - - - - 0 0 15E BEAM ANGLE - - - - - - 0 1 20E BEAM ANGLE - - - - - - 1 0 30E BEAM ANGLE - - - - - - 1 1 OTHER BEAM ANGLE 0 1 0 0 - - - - 4-BEAM JANUS CONFIG 0 1 0 1 - - - - 5-BM JANUS CFIG DEMOD) 1 1 1 1 - - - - 5-BM JANUS CFIG.(2 DEMD) Example: Hex 5249 (i.e., hex 49 followed by hex 52) identifies a 150-kHz system, convex beam pattern, down-facing, 30E beam angle, 5 beams (3 demods).
13,14	7	Reserved	Reserved for TRDI Use
15,16	8	Reserved	Reserved for TRDI Use
17,18	9	#Bm / Number of Beams	Contains the number of beams used to calculate velocity data (not physical beams). The ADCP needs only three beams to calculate water-current velocities. The fourth beam provides an error velocity that determines data validity. If only three beams are available, the ADCP does not make this validity check. The Percent-Good Data Format has more information.
19,20	10	WN / Number of Cells	Contains the number of depth cells over which the ADCP collects data (WN - Broad Bandwidth Profiling Number Of Depth Cells). Scaling: LSD = 1 depth cell; Range = 1 to 128 depth cells
21-24	11,12	WP / Pings Per Ensemble	Contains the number of pings averaged together during a data ensemble (WP-command). If WP = 0, the Ocean Surveyor does not collect the WD water-profile data. Note: The Ocean Surveyor automatically extends the ensemble interval (TE) if the product of WP and time per ping (TP) is greater than TE (i.e., if WP x TP > TE). Scaling: LSD = 1 ping; Range = 0 to 16,384 pings

Table 38: Binary Fixed Leader Data Format

Hex Digit	Binary Byte	Field	Description
25-28	13,14	WS / Depth Cell Length	Contains the length of one depth cell (WS - Broad Bandwidth Profiling Depth Cell Size). Scaling: LSD = 1 centimeter; Range = 1 to 6400 cm (210 feet)
29-32	15,16	WF / Blank after Transmit	Contains the blanking distance used by the ADCP to allow the transmit circuits time to recover before the receive cycle begins (WF - Broad Bandwidth Profiling Blank after Transmit). Scaling: LSD = 1 centimeter; Range = 0 to 9999 cm (328 feet)
33,34	17	Signal Processing Mode	If the profile ping was a broadband ping then it will show 1. If the ping was a narrowband ping then it will show 10.
35,36	18	WC / Broad Bandwidth Profiling Water Correlation Threshold	If the profile ping was a broadband ping, then byte 18 is the value of WC. If the profile ping was a narrowband ping then it is zero.
37,38	19	cr# / No. code reps	Contains the number of code repetitions in the transmit pulse. Scaling: LSD = 1 count; Range = 0 to 255 counts
39,40	20	% Good Minimum	Contains the minimum percentage of water-profiling pings in an ensemble that must be considered good to output velocity data. Scaling: LSD = 1 percent; Range = 1 to 100 percent
41-44	21,22	WE / Error Velocity Threshold	This field, initially set by the WE-command, contains the actual threshold value used to flag water-current data as good or bad. If the error velocity value exceeds this threshold, the ADCP flags all four beams of the affected bin as bad. Scaling: LSD = 1 mm/s; Range = 0 to 5000 mm/s
45,46 47,48 49,50	23 24 25	Minutes Seconds Hundredths	These fields, set by the TP-command, contain the amount of time between ping groups in the ensemble. NOTE: The Ocean Surveyor automatically extends the ensemble interval (set by TE) if (WP x TP > TE).

51,52	26	EX / Coord Transform	Contains the coordinate transformation processing parameters (EX - Coordinate Transformation). These firmware switches indicate how the Ocean Surveyor collected data.
			`xxx00xxx = NO TRANSFORMATION (BEAM COORDINATES)`
			`xxx01xxx = INSTRUMENT COORDINATES`
			`xxx10xxx = SHIP COORDINATES`
			`xxx11xxx = EARTH COORDINATES`
			`xxxxx1xx = TILTS (PITCH AND ROLL) USED IN SHIP OR EARTH TRANSFORMATION`
			`xxxxxx1x = 3-BEAM SOLUTION USED IF ONE BEAM IS BELOW THE CORRELATION THRESHOLD SET BY THE WC-COMMAND`
			`xxxxxxx1 = BIN MAPPING USED`

53-56	27,28	EA / Heading Alignment	Contains a correction factor for physical heading misalignment (EA - Heading Alignment). Scaling: LSD = 0.01 degree; Range = -179.99 to 180.00 degrees
57-60	29,30	EV / Heading Bias	Contains a correction factor for electrical/magnetic heading bias (EV - Heading Bias). Scaling: LSD = 0.01 degree; Range = -179.99 to 180.00 degrees

Table 38: Binary Fixed Leader Data Format

Hex Digit	Binary Byte	Field	Description

61,62	31	EZ / Sensor Source	Contains the selected source of environmental sensor data (EZ - Sensor Source). These firmware switches indicate the following.
			`Field     Description`
			`x1xxxxxx = calculates EC from ED, ES, and ET`
			`xx1xxxxx = uses ED from depth sensor`
			`xxx1xxxx = uses EH from transducer heading sensor`
			`xxxx1xxx = uses EP from transducer pitch sensor`
			`xxxxx1xx = uses ER from transducer roll sensor`
			`xxxxxx1x = uses ES from conductivity sensor`
			`xxxxxxx1 = uses ET from transducer temp sensor`
			NOTE: If the field = 0, or if the sensor is not available, the ADCP uses the manual command setting. If the field = 1, the ADCP uses the reading from the internal sensor or an external synchro sensor (only applicable to heading, roll, and pitch). Although you can enter a "2" in the EZ-command string, the ADCP only displays a 0 (manual) or 1 (int/ext sensor).

63,64	32	SA / Sensors Avail	This field reflects what sensors are available. The bit pattern is the same as listed for the EZ-command (above), except that the EC bit is always zero because there is no speed of sound sensor.
65-68	33,34	dis1 / Bin 1 distance	This field contains the distance to the middle of the first depth cell (bin). This distance is a function of depth cell length (WS), the profiling mode (WM), the blank after transmit distance (WF), and speed of sound. Scaling: LSD = 1 centimeter; Range = 0 to 65535 cm (2150 feet)
69-72	35,36	WT Xmit pulse length	This field, set by the WT-command, contains the length of the transmit pulse. When the ADCP receives a <BREAK> signal, it sets the transmit pulse length as close as possible to the depth cell length (WS-command). This means the ADCP uses a WT command of zero. However, the WT field contains the actual length of the transmit pulse used. Scaling: LSD = 1 centimeter; Range = 0 to 65535 cm (2150 feet)
73-76	37,38	Reserved	Reserved for TRDI Use
77,78	39	WA / False Target Threshold	Contains the threshold value used to reject data received from a false target, usually fish (WA – Broad Bandwidth Profiling False Target Threshold). Scaling: LSD = 1 count; Range = 0 to 255 counts (255 disables)
79,80	40	Reserved	Reserved for TRDI Use
81-84	41,42	LagD / Transmit lag distance	This field, determined mainly by the setting of the WM-command, contains the distance between pulse repetitions. Scaling: LSD = 1 centimeter; Range = 0 to 65535 centimeters
85-118	43-50	Reserved	Reserved for TRDI Use

Binary Variable Leader Data Format

BYTE	BIT POSITIONS 7 6 5 4 3 2 1 0	
1	VARIABLE LEADER ID 80h or 81h	LSB
2	00h	MSB
3	ENSEMBLE NUMBER	LSB
4		MSB
5	SYSTEM DATE YEAR	
6	MONTH	
7	DAY	
8	SYSTEM TIME HOUR	
9	MINUTE	
10	SECOND	
11	HUNDREDTHS	
12	ENSEMBLE # MSB	
13	RESERVED	LSB
14		MSB
15	SPEED OF SOUND {EC}	LSB
16		MSB
17	DEPTH OF TRANSDUCER {ED}	LSB
18		MSB
19	HEADING {EH}	LSB
20		MSB
21	PITCH (TILT 1) {EP}	LSB
22		MSB
23	ROLL (TILT 2) {ER}	LSB
24		MSB
25	SALINITY {ES}	LSB
26		MSB
27	TEMPERATURE {ET}	LSB
28		MSB
29	MINIMUM TIME BETWEEN PING GROUPS MINUTES	
30	SECONDS	
31	HUNDREDTHS	

BYTE	BIT POSITIONS 7	6	5	4	3	2	1	0
32	HEADING STANDARD DEVIATION							
33	PITCH STANDARD DEVIATION							
34	ROLL STANDARD DEVIATION							
35 ↓ 42	RESERVED ↓							
43 44 45 46	ESW							
47 ↓ 60	RESERVED ↓							

Figure 48. Binary Variable Leader Data Format

Variable Leader data refers to the dynamic ADCP data (from clocks and sensors) that change with each ping. The ADCP always sends Variable Leader data as output data (LSBs first). See Command Descriptions for detailed descriptions of commands used to set these values.

Table 39: Binary Variable Leader Data Format

Hex Digit	Binary Byte	Field	Description
1-4	1,2	VID / Variable Leader ID	Stores the Variable Leader identification word 0080 or 0081 (see CW – Select Dual Mode Data). LSB is sent first.

5-8	3,4	Ens / Ensemble Number	This field contains the sequential number of the ensemble to which the data in the output buffer apply.
			Scaling: LSD = 1 ensemble; Range = 1 to 65,535 ensembles
			NOTE: The first ensemble collected is #1. At “rollover,” we have the following sequence:
			`1 = ENSEMBLE NUMBER 1`
			`↓`
			`65535 = ENSEMBLE NUMBER 65,535 ┌ ENSEMBLE`
			`0 = ENSEMBLE NUMBER 65,536 │ #MSB FIELD`
			`1 = ENSEMBLE NUMBER 65,537 └ (BYTE 12) INCR.`

9,10 11,12 13,14 15,16 17,18 19,22 21,22	5 6 7 8 9 10 11	RTC Year RTC Month RTC Day RTC Hour RTC Minute RTC Second RTC Hundredths	These fields contain the time from the ADCP’s real-time clock (RTC) that the current data ensemble began. The TS-command (TS - Set System Date and Time) initially sets the clock. The ADCP does account for leap years.
23-24	12	Ensemble # MSB	This field increments each time the Ensemble Number field (bytes 3 and 4) “rolls over.” This allows ensembles up to 16,777,215. See Ensemble Number field above.
25-28	13,14	Reserved	Reserved for TRDI Use
29-32	15,16	EC / Speed of Sound	Contains either manual or calculated speed of sound information (EC - Speed of Sound). Scaling: LSD = 1 meter per second; Range = 1400 to 1600 m/s
33-36	17,18	ED / Depth of Transducer	Contains the depth of the transducer below the water surface (ED - Depth of Transducer). This value may be a manual setting or a reading from a depth sensor. Scaling: LSD = 1 decimeter; Range = 1 to 9999 decimeters
37-40	19,20	EH / Heading	Contains the ADCP heading angle (EH - Heading Angle). This value may be a manual setting or a reading from a heading sensor. Scaling: LSD = 0.01 degree; Range = 000.00 to 359.99 degrees
41-44	21,22	EP / Pitch (Tilt 1)	Contains the ADCP pitch angle (EP - Pitch and Roll Angles). This value may be a manual setting or a reading from a tilt sensor. Positive values mean that Beam #3 is spatially higher than Beam #4. Scaling: LSD = 0.01 degree; Range = -179.00 to +180.00 degrees
45-48	23,24	ER / Roll (Tilt 2)	Contains the ADCP roll angle (ER - Roll (Tilt 2)). This value may be a manual setting or a reading from a tilt sensor. For up-facing ADCPs, positive values mean that Beam #2 is spatially higher than Beam #1. For down-facing ADCPs, positive values mean that Beam #1 is spatially higher than Beam #2. Scaling: LSD = 0.01 degree; Range = -60.00 to +60.00 degrees

Table 39: Binary Variable Leader Data Format

Hex Digit	Binary Byte	Field	Description
49-52	25,26	ES / Salinity	Contains the salinity value of the water at the transducer head (ES - Salinity). This value may be a manual setting or a reading from a conductivity sensor. Scaling: LSD = 1 part per thousand; Range = 0 to 50 ppt
53-56	27,28	ET / Temperature	Contains the temperature of the water at the transducer head (ET - Temperature). This value may be a manual setting or a reading from a temperature sensor. Scaling: LSD = 0.01 degree; Range = -5.00 to +40.00 degrees
57,58 59,60 61,62	29 30 31	Minutes Seconds Hundredths	Minimum time between ping groups (mm:ss.ff)
63,64	32	HDG STD	Heading Standard Deviation
65,66	33	Pitch STD	Pitch Standard Deviation
67,68	34	Roll STD	Roll Standard Deviation
69-77	35-42	Reserved	Reserved
78,79	43	ESW	Contains the Error Status Word (ESW). The ESW is cleared (set to zero) between each ensemble. LSB BITS 07 06 05 04 03 02 01 00 x x x x x x x 1 Xmit Shutdown x x x x x x 1 x Xmit Over Current x x x x x 1 x x Not used x x x x 1 x x x Not used x x x 1 x x x x Not used x x 1 x x x x x Not used x 1 x x x x x x Not used 1 x x x x x x x Not used
80,81	44	ESW	MSB BITS 15 14 13 12 11 10 09 08 x x x x x x x 1 Not Used x x x x x x 1 x Watchdog Disabled x x x x x 1 x x Not Used x x x x 1 x x x Not Used x x x 1 x x x x Not Used x x 1 x x x x x Not Used x 1 x x x x x x Not used 1 x x x x x x x Not used
82,83	45	ESW	LSB BITS 07 06 05 04 03 02 01 00 x x x x x x x 1 Not used x x x x x x 1 x Not used x x x x x 1 x x Not used x x x x 1 x x x Not used x x x 1 x x x x Not used x x 1 x x x x x Not used x 1 x x x x x x Not used 1 x x x x x x x Not used

Table 39: Binary Variable Leader Data Format

Hex Digit	Binary Byte	Field	Description

84,85	46	ESW	MSB
			`BITS 15 14 13 12 11 10 09 08`
			`     x  x  x  x  x  x  x  1  Not Used`
			`     x  x  x  x  x  x  1  x  Not used`
			`     x  x  x  x  x  1  x  x  Not Used`
			`     x  x  x  x  1  x  x  x  Not Used`
			`     x  x  x  1  x  x  x  x  Not Used`
			`     x  x  1  x  x  x  x  x  Not Used`
			`     x  1  x  x  x  x  x  x  Not used`
			`     1  x  x  x  x  x  x  x  Not used`

86-120	47-60	Reserved	Reserved for TRDI use.

Binary Velocity Data Format

BYTE	7/S	6	5	4	3	2	1	0	
1 2	VELOCITY ID							00h or 01h 01h	LSB MSB
3 4	DEPTH CELL #1, VELOCITY 1								LSB MSB
5 6	DEPTH CELL #1, VELOCITY 2								LSB MSB
7 8	DEPTH CELL #1, VELOCITY 3								LSB MSB
9 10	DEPTH CELL #1, VELOCITY 4								LSB MSB
11 12	DEPTH CELL #2, VELOCITY 1								LSB MSB
13 14	DEPTH CELL #2, VELOCITY 2								LSB MSB
15 16	DEPTH CELL #2, VELOCITY 3								LSB MSB
17 18	DEPTH CELL #2, VELOCITY 4								LSB MSB
↓	(SEQUENCE CONTINUES FOR UP TO 128 CELLS)								↓
1019 1020	DEPTH CELL #128, VELOCITY 1								LSB MSB
1021 1022	DEPTH CELL #128, VELOCITY 2								LSB MSB
1023 1024	DEPTH CELL #128, VELOCITY 3								LSB MSB
1025 1026	DEPTH CELL #128, VELOCITY 4								LSB MSB

Figure 49. Binary Velocity Data Format

The number of depth cells is set by the WN-command.

The ADCP packs velocity data for each depth cell of each beam into a two-byte, two's-complement integer [-32768, 32767] with the LSB sent first. The ADCP scales velocity data in millimeters per second (mm/s). A value of -32768 (8000h) indicates bad velocity values.

Table 40: Binary Velocity Data Format

Hex Digit	Binary Byte	Field	Description
1-4	1,2	Velocity ID	Stores the velocity data identification word 0100 or 0101 (see CW – Select Dual Mode Data). LSB is sent first.
5-8	3,4	Depth Cell 1, Velocity 1	Stores velocity data for depth cell #1, velocity 1. See above.
9-12	5,6	Depth Cell 1, Velocity 2	Stores velocity data for depth cell #1, velocity 2. See above.
13-16	7,8	Depth Cell 1, Velocity 3	Stores velocity data for depth cell #1, velocity 3. See above.
17-20	9,10	Depth Cell 1, Velocity 4	Stores velocity data for depth cell #1, velocity 4. See above.
21-2052	11-1026	Cells 2 - 128 (if used)	These fields store the velocity data for depth cells 2 through 128 (depending on the setting of the WN-command). These fields follow the same format as listed above for depth cell 1.

Binary Correlation Magnitude, Echo Intensity, Percent Good, and Status Format

	BIT POSITIONS								
BYTE	7/S	6	5	4	3	2	1	0	
1	ID CODE								LSB
2									MSB
3	DEPTH CELL #1, FIELD #1								
4	DEPTH CELL #1, FIELD #2								
5	DEPTH CELL #1, FIELD #3								
6	DEPTH CELL #1, FIELD #4								
7	DEPTH CELL #2, FIELD #1								
8	DEPTH CELL #2, FIELD #2								
9	DEPTH CELL #2, FIELD #3								
10	DEPTH CELL #2, FIELD #4								
↓	(SEQUENCE CONTINUES FOR UP TO 128 BINS)								↓
511	DEPTH CELL #128, FIELD #1								
512	DEPTH CELL #128, FIELD #2								
513	DEPTH CELL #128, FIELD #3								
514	DEPTH CELL #128, FIELD #4								

Figure 50. Binary Correlation Magnitude, Echo Intensity, Percent Good and Status Format

The number of depth cells is set by the WN-command.

Correlation magnitude data for Broad Bandwidth ensembles give the magnitude of the normalized echo autocorrelation at the lag used for estimating the Doppler phase change. The ADCP represents this magnitude by a linear scale between 0 and 255, where 255 is perfect correlation (i.e., a solid target).

Correlation magnitude data for Narrow Bandwidth ensembles give the magnitude of the energy (power) in the low pass filter. Values of 170 to 190 counts represent normal levels. Lower values mean a reduced signal to noise ratio.

Table 41: Binary Correlation Magnitude Data Format

Hex Digit	Binary Byte	Field	Description
1-4	1,2	ID Code	Stores the correlation magnitude data identification word 0200 or 0201) see CW – Select Dual Mode Data). LSB is sent first.
5,6	3	Depth Cell 1, Field 1	Stores correlation magnitude data for depth cell #1, beam #1. See above.
7,8	4	Depth Cell 1, Field 2	Stores correlation magnitude data for depth cell #1, beam #2. See above.
9,10	5	Depth Cell 1, Field 3	Stores correlation magnitude data for depth cell #1, beam #3. See above.
11,12	6	Depth Cell 1, Field 4	Stores correlation magnitude data for depth cell #1, beam #4. See above.
13-1028	7-514	Cells 2 - 128 (if used)	These fields store correlation magnitude data for depth cells 2 through 128 (depending on the WN-command) for all four beams. These fields follow the same format as listed above for depth cell 1.

The echo intensity scale factor is about 0.45 dB per ADCP count. The ADCP does not directly check for the validity of echo intensity data.

Table 42: Binary Echo Intensity Data Format

Hex Digit	Binary Byte	Field	Description
1-4	1,2	ID Code	Stores the echo intensity data identification word 0300 or 0301 (see CW – Select Dual Mode Data). LSB is sent first.
5,6	3	Depth Cell 1, Field 1	Stores echo intensity data for depth cell #1, beam #1. See above.
7,8	4	Depth Cell 1, Field 2	Stores echo intensity data for depth cell #1, beam #2. See above.
9,10	5	Depth Cell 1, Field 3	Stores echo intensity data for depth cell #1, beam #3. See above.
11,12	6	Depth Cell 1, Field 4	Stores echo intensity data for depth cell #1, beam #4. See above.
13- 1028	7-514	Cells 2 - 128 (if used)	These fields store echo intensity data for depth cells 2 through 128 (depending on the WN-command) for all four beams. These fields follow the same format as listed above for depth cell 1.

The percent-good data field is a data-quality indicator that reports the percentage (0 to 100) of good data collected for each depth cell of the velocity profile. The setting of the EX-command (Coordinate Transformation) determines how the ADCP references percent-good data as shown below.

EX-Command	Coordinate System	Velocity 1	Velocity 2	Velocity 3	Velocity 4
		Percentage Of Good Pings For:			
xxx**00**xxx	Beam	BEAM 1	BEAM 2	BEAM 3	BEAM 4

EX-Command	Coordinate System	Velocity 1	Velocity 2	Velocity 3	Velocity 4
		Percentage Of:			
xxx**01**xxx xxx**10**xxx xxx**11**xxx	Instrument Ship Earth	3-Beam Transformations (note 1)	Transformations Rejected (note 2)	More Than One Beam Bad In Bin	4-Beam Transformations

Note 1. Because profile data did not exceed correlation threshold (WC command).

Note 2. Because the error velocity threshold was exceeded (WE command).

At the start of the velocity profile, the backscatter echo strength is typically high on all four beams. Under this condition, the ADCP uses all four beams to calculate the orthogonal and error velocities. As the echo returns from far away depth cells, echo intensity decreases. At some point, the echo will be weak enough on any given beam to cause the ADCP to reject some of its depth cell data. This causes the ADCP to calculate velocities with three beams instead of four beams. When the ADCP does 3-beam solutions, it stops calculating the error velocity because it needs four beams to do this. At some further depth cell, the ADCP rejects all cell data because of the weak echo. As an example, let us assume depth cell 60 has returned the following percent-good data.

```
FIELD #1 = 50, FIELD #2 = 5, FIELD #3 = 0, FIELD #4 = 45
```

If the EX-command was set to collect velocities in BEAM coordinates, the example values show the percentage of pings having good solutions in cell 60 for each beam based on the Low Correlation Threshold (WC command). Here, beam 1=50%, beam 2=5%, beam 3=0%, and beam 4=45%. These are neither typical nor desired percentages. Typically, you would want all four beams to be about equal and greater than 25%.

On the other hand, if velocities were collected in Instrument, Ship, or Earth coordinates, the example values show:

Field 1 – Percentage of good 3-beam solutions – Shows percentage of successful velocity calculations (50%) using 3-beam solutions because the correlation threshold (WC command) was not exceeded.

Field 2 – Percentage of transformations rejected – Shows percent of error velocity (5%) that was less than the WE command setting. WE has a default of 5000 mm/s. This large WE setting effectively prevents the ADCP from rejecting data based on error velocity.

Field 3 – Percentage of more than one beam bad in bin – 0% of the velocity data were rejected because not enough beams had good data.

Field 4 – Percentage of good 4-beam solutions – 45% of the velocity data collected during the ensemble for depth cell 60 were calculated using four beams.

Table 43: Binary Percent-Good Data Format

Hex Digit	Binary Byte	Field	Description
1-4	1,2	ID Code	Stores the percent-good data identification word 0400 or 0401 (see CW – Select Dual Mode Data). LSB is sent first.
5,6	3	Depth cell 1, Field 1	Stores percent-good data for depth cell #1, field 1. See above.
7,8	4	Depth cell 1, Field 2	Stores percent-good data for depth cell #1, field 2. See above.
9,10	5	Depth cell 1, Field 3	Stores percent-good data for depth cell #1, field 3. See above.
11,12	6	Depth cell 1, Field 4	Stores percent-good data for depth cell #1, field 4. See above.
13-1028	7-514	Depth cell 2 – 128 (if used)	These fields store percent-good data for depth cells 2 through 128 (depending on the WN-command), following the same format as listed above for depth cell 1.

These fields contain information about the status and quality of ADCP data. A value of 0 means the measurement was good. A value of 1 means the measurement was bad.

Table 44: Binary Status Data Format

Hex Digit	Binary Byte	Field	Description
1-4	1,2	ID Code	Stores the status data identification word 0500 or 0501 (see CW – Select Dual Mode Data). LSB is sent first.
5,6	3	Depth cell 1, Field 1	Stores status data for depth cell #1, beam #1. See above.
7,8	4	Depth cell 1, Field 2	Stores status data for depth cell #1, beam #2. See above.
9,10	5	Depth cell 1, Field 3	Stores status data for depth cell #1, beam #3. See above.
11,12	6	Depth cell 1, Field 4	Stores status data for depth cell #1, beam #4. See above.
13-1028	7-514	Depth cell 2 – 128 (if used)	These fields store status data for depth cells 2 through 128 (depending on the WN command) for all four beams. These fields follow the same format as listed above for depth cell 1.

Binary Bottom-Track Data Format

BYTE#	BIT POSITIONS 7 6 5 4 3 2 1 0	
1	BOTTOM-TRACK ID 00h	LSB
2	06h	MSB
3	BOTTOM-TRACK # OF PINGS {BP}	LSB
4		MSB
5	RESERVED	LSB
6		MSB
7	BT CORR MAG MIN {BC}	
8	BT EVAL AMP MIN {BA}	
9	RESERVED	
10	BOTTOM TRACK MODE {BM}	
11	ERROR VELOCITY MAXIMUM {BE}	
12		
13	RESERVED	
↓		↓
16		
17	BEAM#1 BT RANGE	LSB
18		MSB
19	BEAM#2 BT RANGE	LSB
20		MSB
21	BEAM#3 BT RANGE	LSB
22		MSB
23	BEAM#4 BT RANGE	LSB
24		MSB
25	BEAM#1 BT VEL	LSB
26		MSB
27	BEAM#2 BT VEL	LSB
28		MSB
29	BEAM#3 BT VEL	LSB
30		MSB
31	BEAM#4 BT VEL	LSB
32		MSB

BYTE#	7	6	5	4	3	2	1	0	
	BIT POSITIONS								
33	BEAM#1 BT CORR.								
34	BEAM#2 BT CORR.								
35	BEAM#3 BT CORR.								
36	BEAM#4 BT CORR.								
37	BEAM#1 EVAL AMP								
38	BEAM#2 EVAL AMP								
39	BEAM#3 EVAL AMP								
40	BEAM#4 EVAL AMP								
41 ↓ 70	RESERVED								↓
71	BT MAXIMUM DEPTH {BX}								LSB
72									MSB
73	BM#1 RSSI AMP								
74	BM#2 RSSI AMP								
75	BM#3 RSSI AMP								
76	BM#4 RSSI AMP								
77	GAIN								
78	(*SEE BYTE 17)								MSB
79	(*SEE BYTE 19)								MSB
80	(*SEE BYTE 21)								MSB
81	(*SEE BYTE 23)								MSB

Figure 51. Binary Bottom-Track Data Format

This data is output only if the BP-command is >0 and PD0 is selected.

The LSB is always sent first. See Command Descriptions for detailed descriptions of commands used to set these values.

Table 45: Binary Bottom-Track Data Format

Hex Digit	Binary Byte	Field	Description
1-4	1,2	ID Code	Stores the bottom-track data identification word 0600 or 0601 (see CW – Select Dual Mode Data). LSB is sent first.
5-8	3,4	BP / BT # Pings	Stores the BP-command (see BP - Bottom-Track Pings). If BP = zero, the ADCP does not collect bottom-track data. The ADCP automatically extends the ensemble interval (TE) if BP x TP > TE.
9-12	5,6	Reserved	Reserved
13,14	7	BC / BT Corr Mag Min	Stores the minimum correlation magnitude value (BC - Correlation Threshold). Scaling: LSD = 1 count; Range = 0 to 255 counts
15,16	8	BA / BT Eval Amp Min	Stores the minimum evaluation amplitude value (BA - Amplitude Threshold). Scaling: LSD = 1 count; Range = 1 to 255 counts
17,18	9	Reserved	Reserved – always 0
19,20	10	BM/BT Mode	Stores the bottom-tracking mode (BM-command).
21-24	11,12	BE/BT Err Vel Max	Stores the error velocity maximum value (BE - Error Velocity Threshold). Scaling: LSD = 1 mm/s; Range = 0 to 5000 mm/s (0 = did not screen data)
25-32	13–16	Reserved	Reserved
33-48	17-24	BT Range / Beam #1-4 BT Range	Contains the two lower bytes of the vertical range from the ADCP to the sea bottom (or surface) as determined by each beam. This vertical range does not consider the effects of pitch and roll. When bottom detections are bad, BT Range = 0. See bytes 78 through 81 for MSB description and scaling. Scaling: LSD = 1 cm; Range = 0 to 65535 cm
49-64	25-32	BT Velocity / Beam #1-4 BT Vel	The meaning of the velocity depends on the EX command setting (EX - Coordinate Transformation). The four velocities are as follows: a) Beam Coordinates: Beam 1, Beam 2, Beam 3, Beam 4 b) Instrument Coordinates: 1->2, 4->3, toward face, error c) Ship Coordinates: Stbd, Fwd, Upward, Error d) Earth Coordinates: East, North, Upward, Error
65-72	33-36	BTCM / Beam #1-4 BT Corr.	Contains the correlation magnitude in relation to the sea bottom (or surface) as determined by each beam. Bottom-track correlation magnitudes have the same format and scale factor as water-profiling magnitudes.
73-80	37-40	BTEA / Beam #1-4 BT Eval Amp	Contains the evaluation amplitude of the matching filter used in determining the strength of the bottom echo. Scaling: LSD = 1 count; Range = 0 to 255 counts
81-88	41-44	Reserved	Reserved

Table 45: Binary Bottom-Track Data Format

Hex Digit	Binary Byte	Field	Description
89-100	45-50	Reserved	Reserved
101-140	51-70	Reserved	Reserved
141-144	71,72	BX / BT Max. Depth	Stores the maximum tracking depth value (BX - Maximum Tracking Depth). Scaling: LSD = 1 decimeter; Range = 80 to 9999 decimeters
145-152	73-76	RSSI/Bm #1-4 RSSI Amp	Contains the Receiver Signal Strength Indicator (RSSI) value in the center of the bottom echo as determined by each beam. Scaling: LSD = ≈ 0.45 dB per count; Range = 0 to 255 counts
153,154	77	GAIN	Contains the Gain level for shallow water.
155-162	78-81	BT Range MSB / Bm #1-4	Contains the most significant byte of the vertical range from the ADCP to the sea bottom (or surface) as determined by each beam. This vertical range does not consider the effects of pitch and roll. When bottom detections are bad, BT Range=0. See bytes 17 through 24 for LSB description and scaling. Scaling: LSD = 65,536 cm, Range = 65,536 to 16,777,215 cm

Binary Fixed Attitude Data Format

	BIT POSITIONS								
BYTE	7	6	5	4	3	2	1	0	
1	FIXED ATTITUDE ID						00h		LSB
2							30h		MSB
3	Attitude Output Coordinates and Processing Control using Interpolated Attitude (EE)								
4									
5									
6									
7									
8									
9									
10									
11	External Pitch/Roll Scaling (EF)								
12	Fixed Heading Scaling (EH)								
13									
14									
15	Roll Misalignment (EI)								
16									

17 18	Pitch Misalignment (EJ)
19 20 21 22 23	User Input for Pitch, Roll, and Coordinate Frame (EP)
24	User Input for Up/Down Orientation (EU)
25 26	User Input for Heading Bias/Variation/Synchro Offset (EV)
27 ↓ 34	Sensor Source (EZ)

Figure 52. Binary Fixed Attitude Data Format

Fixed Attitude data refers to the dynamic ADCP data (from heading, pitch, and roll sensors) that change with each ping. The ADCP will output Fixed Attitude data as output data (LSBs first). See Command Descriptions for detailed descriptions of commands used to set these values.

Table 46: Binary Fixed Attitude Data Format

Hex Digit	Binary Byte	Field	Description
1-4	1,2	FAID / Fixed Attitude ID	Stores the Fixed Attitude identification word 3000. LSB is sent first.
5-20	3-10	Attitude Output Coordinates	Stores the user input for the Variable Attitude data to be output (EE - Attitude Data Output and Interpolation)
21,22	11	External Pitch/Roll Scaling	Stores the user input for scaling the external synchro input for pitch and roll (EF - External Pitch/Roll Factor)
23-28	12-14	Fixed Heading Scaling	Stores the user input for heading (EH - Heading Angle)
29-32	15,16	Roll Misalignment	Stores the user input for the roll misalignment (EI - Roll Misalignment Angle)
33-36	17,18	Pitch Misalignment	Stores the user input for the pitch misalignment (EJ - Pitch Misalignment Angle)
37-46	19-23	Pitch, Roll and Coordinate Frame	Stores the user input for the pitch, roll, and coordinate (instrument or ship) frame (EP - Pitch and Roll Angles)
47,48	24	Orientation	Stores the user input for the up/down orientation (EU - Up/Down Orientation)
49-52	25,26	Heading Offset	Stores the user input for the heading offset due to heading bias, variation, or synchro initialization (EV - Heading Bias)
53-68	27-34	Sensor Source	Stores the user input defining the use of internal, external, or fixed sensors (EZ - Sensor Source)

Binary Variable Attitude Data Format

BYTE	BIT POSITIONS 7	6	5	4	3	2	1	0	
1	VARIABLE ATTITUDE ID 3040 - 30FC							40 - FC	LSB
2								30	MSB
3	Heading Water/Bottom Ping Type 1								LSB
4									MSB
5	Pitch Water/Bottom Ping Type 1								LSB
6									MSB
7	Roll Water/Bottom Ping Type 1								LSB
8									MSB
9	Heading Rate Water/Bottom Ping Type 1								LSB
10									MSB
11	Pitch Rate Water/Bottom Ping Type 1								LSB
12									MSB
13	Roll Rate Water/Bottom Ping Type 1								LSB
14									MSB
15	Heading Water/Bottom Ping Type 2								LSB
16									MSB
17	Pitch Water/Bottom Ping Type 2								LSB
18									MSB
19	Roll Water/Bottom Ping Type 2								LSB
20									MSB
21	Heading Rate Water/Bottom Ping Type 2								LSB
22									MSB
23	Pitch Rate Water/Bottom Ping Type 2								LSB
24									MSB
25	Roll Rate Water/Bottom Ping Type 2								LSB
26									MSB
↓	(Sequence Continues up to 8 Water/Bottom Ping Types)								↓

BYTE	BIT POSITIONS 7	6	5	4	3	2	1	0	
75	Heading Water/Bottom Ping Type 7								LSB
76									MSB
77	Pitch Water/Bottom Ping Type 7								LSB
78									MSB
79	Roll Water/Bottom Ping Type 7								LSB
80									MSB
81	Heading Rate Water/Bottom Ping Type 7								LSB
82									MSB
83	Pitch Rate Water/Bottom Ping Type 7								LSB
84									MSB
85	Roll Rate Water/Bottom Ping Type 7								LSB
86									MSB
87	Heading Water/Bottom Ping Type 8								LSB
88									MSB
89	Pitch Water/Bottom Ping Type 8								LSB
90									MSB
91	Roll Water/Bottom Ping Type 8								LSB
92									MSB
93	Heading Rate Water/Bottom Ping Type 8								LSB
94									MSB
95	Pitch Rate Water/Bottom Ping Type 8								LSB
96									MSB
97	Roll Rate Water/Bottom Ping Type 8								LSB
98									MSB

Figure 53. Binary Variable Attitude Data Format

The number of Water/Bottom Ping Types varies based on the setting of the EE, WP, NP, and BP commands.

Fixed Attitude data refers to the dynamic ADCP data (from heading, pitch, and roll sensors) that change with each ping. The ADCP will output Fixed Attitude data as output data (LSBs first). See Command Descriptions for detailed descriptions of commands used to set these values.

The Variable Attitude identification word varies depending on the setting of the EE, NP, WP BP, and BK commands. See Table 47 for details on which ID to expect based on these command settings.

Table 47: Variable Attitude Identification Word

EE bits ab	#HPR (WP_{NB})	#HPR (WP_{BB})	#HPR (BP_{BB})	Data Type ID LSB MSB
00	X	X	X	No Output
Instrument				
01	0	0	0	40 30h
01	0	0	0	44 30h
01	0	0	1	48 30h
01	0	0	1	4C 30h
01	0	1	0	50 30h
01	0	1	0	54 30h
01	0	1	1	58 30h
01	0	1	1	5C 30h
01	1	0	0	60 30h
01	1	0	0	64 30h
01	1	0	1	68 30h
01	1	0	1	6C 30h
01	1	1	0	70 30h
01	1	1	0	74 30h
01	1	1	1	78 30h
01	1	1	1	7C 30h
Ship				
10	0	0	0	80 30h
10	0	0	0	84 30h
10	0	0	1	88 30h
10	0	0	1	8C 30h
10	0	1	0	90 30h
10	0	1	0	94 30h
10	0	1	1	98 30h
10	0	1	1	9C 30h
10	1	0	0	A0 30h
10	1	0	0	A4 30h
10	1	0	1	A8 30h
10	1	0	1	AC 30h
10	1	1	0	B0 30h
10	1	1	0	B4 30h
10	1	1	1	B8 30h
10	1	1	1	BC 30h
Instrument and Ship				
11	0	0	0	C0 30h
11	0	0	0	C4 30h
11	0	0	2	C8 30h
11	0	0	2	CC 30h
11	0	2	0	D0 30h
11	0	2	0	D4 30h
11	0	2	2	D8 30h
11	0	2	2	DC 30h
11	2	0	0	E0 30h
11	2	0	0	E4 30h
11	2	0	2	E8 30h
11	2	0	2	EC 30h
11	2	2	0	F0 30h
11	2	2	0	F4 30h
11	2	2	2	F8 30h
11	2	2	2	FC 30h

Notes for Table 47:

1. Columns 2 to 4 represent the number of basic attitude structures that are present for each of the different ping types. The meanings of the column headings are as follows:

#HPR (WP_{NB})	#HPR (WP_{BB})	#HPR (BP_{BB})
Narrowband Profile	Broadband Profile	Broadband Bottom Ping

   Non-zero entries in these columns represent non-zero values for the number of basic attitude structures in each ping type.
2. The sensor source is determined by the EZ command.
3. Coordinate transformations are applied as needed based on the requested coordinate frame of the output data and the coordinate frame of the sensor source.
4. The EV command value is added to the heading data in the ensemble output.
5. For the case of multiple pings per ensemble, the attitude data is the average, for each heading, pitch and roll angle separately, over all pings of like ping type in the ensemble.
6. The Ocean Surveyor/Observer always sends the Least Significant Byte (LSB) first. For example, the ID code for F4 30h is 30F4.

Table 48: Binary Variable Attitude Data Format

Hex Digit	Binary Byte	Field	Description
1-4	1,2	VAID / Variable Attitude ID	Stores the Variable Attitude identification word (range 3040 to 30FC, see Table 47). LSB is sent first.
5-8	3,4	Heading Water/Bottom Ping Type 1	Stores the Heading value for the first Ping Type recorded. A Ping Type is defined based on the EE command setting and then on the NP, WP, BP, and BK commands. The EE command decides if the heading data for this Ping Type will be relative to the Instrument or Ship coordinate. The NP, WP, BP, and BK commands decide if the heading data for this Ping Type will be for the Narrow Bandwidth Water Ping, the Broad Bandwidth Water Ping, the Bottom Track Ping, or the Bottom Water Reference Layer Ping.
9-12	5,6	Pitch Water/Bottom Ping Type 1	Stores the Pitch value for the first Ping Type recorded. A Ping Type is defined based on the EE command setting and then on the NP, WP, BP, and BK commands. The EE command decides if the pitch data for this Ping Type will be relative to the Instrument or Ship coordinate. The NP, WP, BP, and BK commands decide if the pitch data for this Ping Type will be for the Narrow Bandwidth Water Ping, the Broad Bandwidth Water Ping, the Bottom Track Ping, or the Bottom Water Reference Layer Ping.
13-16	7,8	Roll Water/Bottom Ping Type 1	Stores the Roll value for the first Ping Type recorded. A Ping Type is defined based on the EE command setting and then on the NP, WP, BP, and BK commands. The EE command decides if the roll data for this Ping Type will be relative to the Instrument or Ship coordinate. The NP, WP, BP, and BK commands decide if the roll data for this Ping Type will be for the Narrow Bandwidth Water Ping, the Broad Bandwidth Water Ping, the Bottom Track Ping, or the Bottom Water Reference Layer Ping.
17-20	9,10	Heading Rate Water/Bottom Ping Type 1	Stores the Heading Rate value for the first Ping Type recorded. A Ping Type is defined based on the EE command setting and then on the NP, WP, BP, and BK commands. The EE command decides if the heading rate data for this Ping Type will be relative to the Instrument or Ship coordinate. The NP, WP, BP, and BK commands decide if the heading rate data for this Ping Type will be for the Narrow Bandwidth Water Ping, the Broad Bandwidth Water Ping, the Bottom Track Ping, or the Bottom Water Reference Layer Ping.
21-24	11,12	Pitch Rate Water/Bottom Ping Type 1	Stores the Pitch Rate value for the first Ping Type recorded. A Ping Type is defined based on the EE command setting and then on the NP, WP, BP, and BK commands. The EE command decides if the pitch rate data for this Ping Type will be relative to the Instrument or Ship coordinate. The NP, WP, BP, and BK commands decide if the pitch rate data for this Ping Type will be for the Narrow Bandwidth Water Ping, the Broad Bandwidth Water Ping, the Bottom Track Ping, or the Bottom Water Reference Layer Ping.

Table 48: Binary Variable Attitude Data Format

Hex Digit	Binary Byte	Field	Description
25-28	13,14	Roll Rate Water/Bottom Ping Type 1	Stores the Roll Rate value for the first Ping Type recorded. A Ping Type is defined based on the EE command setting and then on the NP, WP, BP, and BK commands. The EE command decides if the roll rate data for this Ping Type will be relative to the Instrument or Ship coordinate. The NP, WP, BP, and BK commands decide if the roll rate data for this Ping Type will be for the Narrow Bandwidth Water Ping, the Broad Bandwidth Water Ping, the Bottom Track Ping, or the Bottom Water Reference Layer Ping.
29-196	15-98	Ping Types 2-8 if used	Repeat of the previous 12 bytes for each Ping type. NOTE: Ping Types are defined in the order of NP, WP, BP, and BK. Ping Type 1 output will be the first command that is greater than 1. That is, if NP>1 and WP=0 then Ping Type 1 will be for the value for the Narrow Bandwidth Water Ping. If NP=0 and WP>0 then Ping Type 1 will be for the value for the Broad Bandwidth Water Ping. The first command setting in the order of NP, WP, BP, and BK that is greater than zero becomes Ping Type 1. Then based on the EE command this data may be relative to the instrument or to the ship. If both instrument and ship are selected by the EE command then the Ping Type 1 will be instrument and Ping Type 2 will be ship.

Binary Navigation Data Format

BYTE#	BIT POSITIONS 7	6	5	4	3	2	1	0	
1	NAVIGATION ID						00h		LSB
2							20h		MSB
3	UTC DAY								
4	UTC MONTH								
5	UTC YEAR								LSB
6									MSB
7	UTC TIME OF FIRST FIX								LSB
8									
9									
10									MSB
11	PC CLOCK OFFSET FROM UTC								LSB
12									
13									
14									MSB
15	FIRST LATITUDE								LSB
16									
17									
18									MSB
19	FIRST LONGITUDE								LSB
20									
21									
22									MSB
23	UTC TIME OF LAST FIX								LSB
24									
25									
26									MSB
27	LAST LATITUDE								LSB
28									MSB
29									LSB
30									MSB

BYTE#	BIT POSITIONS 7	6	5	4	3	2	1	0	
31	LAST LONGITUDE								LSB
32									MSB
33									LSB
34									MSB
35	AVG SPEED								LSB
36									MSB
37	AVG TRACK TRUE								LSB
38									MSB
39	AVG TRACK MAGNETIC								LSB
40									MSB
41	SPEED MADE GOOD								LSB
42									MSB
43	DIRECTION MADE GOOD								LSB
44									MSB
45	RESERVED								
46									
47	FLAGS								
48									
49	RESERVED								
50									
51	ADCP ENSEMBLE NUMBER								LSB
52									
53									
54									MSB
55	ADCP ENSEMBLE YEAR								LSB
56									MSB
57	ADCP ENSEMBLE DAY								
58	ADCP ENSEMBLE MONTH								
59	ADCP ENSEMBLE TIME								
60									
61									
62									

BYTE#	BIT POSITIONS 7	6	5	4	3	2	1	0	
63	PITCH								LSB
64									MSB
65	ROLL								LSB
66									MSB
67	HEADING								LSB
68									MSB
69	NUMBER OF SPEED AVG								LSB
70									MSB
71	NUMBER OF TRUE TRACK AVG								LSB
72									MSB
73	NUMBER OF MAG TRACK AVG								LSB
74									MSB
75	NUMBER OF HEADING AVG								LSB
76									MSB
77	NUMBER OF PITCH/ROLL AVG								LSB
78									MSB

Figure 54. Binary Navigation Data Format

This data is output in this format only by the *VmDas* program in the STA and LTA data files.

These fields contain the Navigation Data. This data is only recorded in the STA and LTA files created by the TRDI Windows software program *VmDas*. The LSB is always sent first. See Command Descriptions for detailed descriptions of commands used to set these values.

Table 49: Binary Navigation Data Format

Hex Digit	Binary Byte	Field	Description
1-4	1,2	ID Code	Stores the sum of velocities identification word 2000. LSB is sent first.
5-6	3	UTC Day	This field contains the UTC Day.
7-8	4	UTC Month	This field contains the UTC Month.
9-12	5,6	UTC Year	This field contains the UTC Year, i.e. i.e. 07CF = 1999
13-20	7-10	UTC Time of first fix	UTC time since midnight; LSB = 0.01 seconds
21-28	11-14	PC Clock offset from UTC	PC Time – UTC (signed); LSB = milliseconds

29-36	15-18	First Latitude	This the first latitude position received after the previous ADCP ping.
			LSB=approx. 8E-8 deg (32-bit BAM)
			In the BAM (Binary Angular Measure) format, the most significant bit of the word has a weight of 180 degrees, and you keep dividing by 2 as you proceed to the right. The lease significant bit for a 32-bit BAM is about 8E-8 arc degrees ($180/2^{31}$), or just under 1 cm of longitudinal distance at the equator, where 1 arc minute = 1 Nautical mile. If you interpret the BAM word as an unsigned number, the range is 0 to (360-lsb) degrees, and if you interpret the BAM as a signed number, the range is –180 to (180-lsb) degrees. The least significant bit for a 16-bit BAM is about 0.0055 degrees ($180/2^{15}$). Some 32-bit BAM examples are:
			UNSIGNED
			`0x40000000  90 degrees`
			`0x80000000  180 degrees`
			`0xC0000000  270 degrees`
			`0xFFFFFFFF  360 degrees minus one LSB degrees`
			SIGNED
			`0x40000000  90 degrees`
			`0x80000000  minus 180 degrees`
			`0xC0000000  minus 90 degrees`
			`0xFFFFFFFF  minus one LSB degrees`

37-44	19-22	First Longitude	This is the first longitude position received after the previous ADCP ping. LSB=approx. 8E-8 deg (32-bit BAM)
45-52	23-26	UTC Time of last fix	Time since midnight UTC; LSB=1E-4 seconds
53-60	27-30	Last Latitude	This is the last latitude position received prior to the current ADCP ping. LSB=approx. 8E-8 deg (32-bit BAM)
61-68	31-34	Last Longitude	This is the last longitude position received prior to the current ADCP ping. LSB=approx. 8E-8 deg (32-bit BAM)
69-72	35,36	Avg Speed	Average Navigational Speed mm/sec (signed)

Table 49: Binary Navigation Data Format

Hex Digit	Binary Byte	Field	Description
73-76	37,38	Avg Track True	Average True Navigational Ship Track Direction LSB=approx. 0.0055 deg (16-bit BAM)
77-80	39,40	Avg Track Magnetic	Average Magnetic Navigational Ship Track Direction LSB=approx. 0.0055 deg (16-bit BAM)
81-84	41,42	Speed Made Good (SMG)	Speed calculated between navigation positions. LSB=one mm/sec (signed) The Speed Made Good (SMG) and Direction Made Good (DMG) quantities are calculated from the navigation fixes that enter the system between ADCP outputs, and are calculated as follows: If: aLat(i) = the average of the latitudes of the nav fixes in interval i aLon(i) = the average of the longitudes of the nav fixes in interval i Ta(i) = the average of the time of validity of the nav fixes in interval i dLat = the difference in average latitude between averaging intervals dLon = the difference in average longitude between averaging intervals VelMGn (i) = the velocity made good in the North direction for interval i VelMGe (i) = the velocity made good in the East direction for interval i LatToDist (dLat) is a function that converts delta Latitude to a distance LonToDist (dLon) is a function that converts delta Longitude to a distance Smg (i) = speed made good in interval i Dmg (i) = direction made good in interval i Then: dLat = (aLat (i-1) – aLat (i)) dLon = (aLon (i-1) – aLon (i)) VelMgn (i) = LatToDist (dLat) / (Ta(i-1) – Ta(i)) VelMge (i) = LonToDist (dLon) / (Ta(i-1) – Ta(i)) Smg(i) = sqrt(VelMGn(i)^2 + VelMGe(i)^2) Dmg(i) = atan(VelMGe(i) / VelMGn(i))
85-88	43,44	Direction Made Good (DMG)	Direction calculated between navigation positions. LSB = approx. 0.0055 deg (16-bit BAM)
89-92	45,46	Reserved	Reserved for TRDI use.

Table 49: Binary Navigation Data Format

Hex Digit	Binary Byte	Field	Description
93-96	47,48	Flags	Describes the validity of the data. Each bit has represents a separate flag and has its own meaning 1=true, 0=false. The flag bits are defined as follows: bit 0 = Data updated bit 1 = PSN Valid bit 2 = Speed Valid bit 3 = Mag Track Valid bit 4 = True Track Valid bit 5 = Date/Time Valid bit 6 = SMG/DMG Valid bit 7 = Pitch/Roll Valid bit 8 = Heading Valid bit 9 = ADCP Time Valid bit 10 = Clock Offset Valid bit 11 = Reserved bit 12 = Reserved bit 13 = Reserved bit 14 = Reserved bit 15 = Reserved
97-100	49,50	Reserved	Reserved for TRDI use.
101-108	51-54	ADCP Ensemble Number	This field contains the sequential number of the ensemble to which the data in the output buffer apply. Scaling: LSD = 1 ensemble; Range = 1 to 4,294,967,296 ensembles
109-112	55,56	ADCP Ensemble Year	This field contains the ADCP year, i.e. 07CFH = 1999
113-114	57	ADCP Ensemble Day	This field contains the ADCP day.
115-116	58	ADCP Ensemble Day	This field contains the ADCP month.
117-124	59-62	ADCP Ensemble Time	Number of seconds since midnight; LSB = 0.01 seconds
125-128	63,64	Pitch	Pitch angle. LSB = approx. 0.0055 deg (16-bit BAM). Pitch is positive when bow is higher than stern.
129-132	65,66	Roll	Roll angle. LSB =approx. 0.0055 deg (16-bit BAM). Roll is positive when the port side is higher than the starboard side.
133-136	67,68	Heading	Heading input. LSB =approx. 0.0055 deg (16-bit BAM)
137-140	69,70	Number of Speed Samples Averaged	The number of speed samples averaged since the previous ADCP ping.
141-144	71,72	Number of True Track Samples Avg	The number of True Track samples averaged since the previous ADCP ping.
145-148	73,74	Number of Magnetic Track Samples Avg	The number of Magnetic Track samples averaged since the previous ADCP ping.
140-152	75,76	Number of Heading Samples Averaged	The number of Heading samples averaged since the previous ADCP ping.
153-156	77,78	Number of Pitch/Roll Samples Averaged	The number of Pitch/Roll samples averaged since the previous ADCP ping.

Binary Reserved BIT Use

	BIT POSITIONS							
BYTE	7	6	5	4	3	2	1	0
1	RESERVED FOR TRDI USE							
2								

Figure 55. Binary Reserved BIT Use

Table 50: Binary Reserved for TRDI Format

Hex Digit	Binary Byte	Field	Description
1-28	1-2	Reserved for TRDI's use	This field is for TRDI (internal use only).

Binary Checksum Data Format

	BIT POSITIONS								
BYTE	7	6	5	4	3	2	1	0	
1	CHECKSUM DATA								LSB
2									MSB

Figure 56. Binary Checksum Data Format

Table 51: Binary Checksum Data Format

Hex Digit	Binary Byte	Field	Description
1-4	1,2	Checksum Data	This field contains a modulo 65536 checksum. The ADCP computes the checksum by summing all the bytes in the output buffer excluding the checksum.

NOTES

Appendix A

NOTICE OF COMPLIANCE

In this chapter, you will learn:

- China RoHS requirements
- Material disclosure table
- Other Directives

Date of Manufacture

China RoHS requires that all Electrical and Electronic Products are marked with a Date of Manufacture. This is the starting point for the Environmental Friendly Use Period, described below.

Environmental Friendly Use Period (EFUP)

Per SJ/T 11364-2006 – Product Marking, the EFUP is defined as the time in years in which hazardous/toxic substances within Electrical and Electronic Products (EIP) will not, under normal operating conditions, leak out of the Product, or the Product will not change in such a way as to cause severe environmental pollution, injury to health, or great damage to property. TRDI has determined the Environmental Friendly Use Period shall be Ten (10) years.

The purpose of the marking is to assist in determining the restricted substance content, recyclability, and environmental protection use period of our covered products, as required in Chinese law, and does not reflect in any way the safety, quality, or warranty associated with these TRDI products.

Some homogenous substance within the EIP contains toxic or hazardous substances or elements above the requirements listed in SJ/T 11363-2006. These substances are identified in Table 52.

WEEE

The mark shown to the left is in compliance with the Waste Electrical and Electronic Equipment Directive 2002/96/EC (WEEE).

This symbol indicates the requirement NOT to dispose the equipment as unsorted municipal waste, but use the return and collection systems according to local law or return the unit to one of the TRDI facilities below.

Teledyne RD Instruments USA	**Teledyne RD Instruments Europe**	**Teledyne RD Technologies**
14020 Stowe Drive Poway, California 92064	2A Les Nertieres 5 Avenue Hector Pintus 06610 La Gaude, France	1206 Holiday Inn Business Building 899 Dongfang Road, Pu Dong Shanghai 20122 China

Material Disclosure Table

In accordance with SJ/T 11364-2006, the following table disclosing toxic or hazardous substances contained in the product is provided.

Table 52: Toxic or Hazardous Substances and Elements Contained in Product

零件项目(名称) Component Name	有毒有害物质或元素 Toxic or Hazardous Substances and Elements					
	铅 Lead (Pb)	汞 Mercury (Hg)	镉 Cadmium (Cd)	六价铬 Hexavalent Chromium (Cr^{6+})	多溴联苯 Polybrominated Biphenyls (PBB)	多溴二苯醚 Polybrominated Diphenyl Ethers (PBDE)
换能器装配件 Transducer Assy.	X	O	O	O	O	O
接收机电路板 Receiver PCB	X	O	O	O	O	O
声纳波束形成电路板 Beamformer PCB	X	O	O	O	O	O
罗盘装配件 Compass Assy. *	X	O	O	O	O	O
底座装配件 End-Cap Assy.	X	O	O	O	O	O
机架装配件 Chassis Assy.	X	O	O	O	O	O
主机电路板装配件 Mother Board Assy.	X	O	O	O	O	O
功率装配件 Power Assy.	X	O	O	O	O	O
换能器接口电路板 Transducer Intfc PCB	X	O	O	O	O	O
数据输入输出电路板 Data I/O Intfc PCB	X	O	O	O	O	O
面板接口电路板 Front Panel Intfc PCB	X	O	O	O	O	O
外接电缆 External Cables	X	O	O	O	O	O
水下专用电缆 Underwater Cable	X	O	O	O	O	O

O: 表示该有毒或有害物质在该部件所有均质材料中的含量均在 SJ/T 11363-2006 标准规定的限量要求以下。

O: Indicates that the toxic or hazardous substance contained in all of the homogeneous materials for this part is below the limit required in SJ/T 11363-2006.

X: 表示该有毒或有害物质至少在该部件的某一均质材料中的含量超出 SJ/T 11363-2006 标准规定的限量要求。

X: Indicates that the toxic or hazardous substance contained in at least one of the homogeneous materials used for this part is above the limit requirement in SJ/T 11363-2006.

Other Directives

Conformity to relevant Union harmonisation legislation:

- Electromagnetic Compatibility directive 2014/30/EU
- Low voltage electrical equipment directive 2014/35/EU.

Standards and verifications used to verify compliance with the directives:

- Electromagnetic compatibility
  - Emissions per EN60945, fourth edition, 2002
  - Immunity by TRDI compliance standard RDI-CMPL-001
- Low Voltage
  - Compliance by TRDI compliance standard RDI-CMPL-002