

WorkHorse Horizontal ADCP Operation Manual



P/N 957-6212-00 (December 2008)

Table of Contents

1	Introduction	1
1.1	How to Contact Teledyne RD Instruments	1
1.2	Notice of Compliance	2
1.2.1	Date of Manufacture	2
1.2.2	Environmental Friendly Use Period (EFUP)	2
1.2.3	WEEE	2
1.2.4	Material Disclosure Table.....	3
1.3	Conventions Used in this Manual.....	4
1.3.1	Abbreviations	4
1.4	Getting Started.....	4
1.5	H-ADCP Care	5
1.5.1	General Handling Guidelines	5
1.5.2	Assembly Guidelines	6
1.5.3	Deployment Guidelines	6
1.6	System Overview	7
2	Installation	10
2.1	H-ADCP Orientation.....	10
2.2	Attach H-ADCP to Structure.....	10
2.3	H-ADCP Wave System Installation Checklist.....	11
2.4	Testing the Installed H-ADCP	15
2.5	Periodic Maintenance	17
2.6	Cabling Considerations	18
2.7	Computer Considerations	19
2.8	Power Considerations.....	19
2.9	12 VDC Power Considerations	20
3	Maintenance	21
3.1	I/O Cable and Dummy Plug	21
3.2	H-ADCP Disassembly.....	22
3.2.1	Housing Removal Procedures – 300/600 kHz H-ADCPs.....	22
3.2.2	Housing Removal Procedures – 300 NB kHz H-ADCPs.....	24
	300 kHz Narrow Beam Width End-Cap Removal Procedures	24
	300 kHz Narrow Beam Width Transducer Head Assembly Removal.....	25
3.3	H-ADCP Re-assembly	25
3.3.1	O-ring Inspection and Replacement.....	26
3.3.2	Housing Replacement.....	27
	300 kHz Narrow Beam Width End-Cap Replacement.....	29
	300 kHz Narrow Beam Width Transducer Head Replacement	30
3.4	Zinc Anode Inspection and Replacement	34
3.4.1	Zinc Anode Inspection	34
3.4.2	Zinc Anode Electrical Continuity Check	34
3.4.3	Zinc Anode Replacement.....	35
3.5	Compass Calibration.....	36
3.5.1	Preparing for Calibration	36
3.5.2	Compass Calibration Verification	36
3.5.3	Compass Calibration Procedure	37
3.6	Fuse Replacement.....	38
3.7	Communications Setting	39
3.8	PC Card Recorder	39
3.9	Desiccant Bags	40
3.10	Sealing the H-ADCP for a Deployment	41
3.11	Protective Coating Inspection and Repair	41
3.12	Prevention of Biofouling	42
3.12.1	Controlling Biofouling	43
3.12.2	Antifouling Paints	44
3.12.3	Applying Antifouling Paints.....	44
3.13	Pressure Sensor	45
3.13.1	Pressure Sensor Maintenance.....	46
3.14	Storage and Shipping Maintenance	47

3.14.1	Removal of Biofouling	47
3.14.2	Transducer Head Inspection	48
3.14.3	Final Storage or Shipping Preparation	48
3.15	Replaceable Parts	49
4	Data Recovery	51
4.1	Recover the Entire Recorder with the WinSC Program	51
4.2	Recover a Single File using BBTalk	51
4.3	Recover the Entire Recorder using BBTalk	51
4.4	Recover a Single File Using Direct Commands	52
4.5	Recover the Entire Recorder Using Direct Commands	53
5	Testing the H-ADCP	54
6	Troubleshooting	57
6.1	Basic Steps in Troubleshooting	57
6.2	Troubleshooting the H-ADCP	58
6.2.1	Troubleshooting Safety	58
6.2.2	Troubleshooting a Communication Failure	59
	Incorrect Wakeup Message	60
	No Wakeup Message	60
6.2.3	Check the Power	61
6.2.4	Check the I/O Cable	61
6.2.5	H-ADCP Checks	62
6.3	Troubleshooting a Built-In Test Failure	62
6.3.1	When to use the Spare Boards Kit	63
6.3.2	Installation of the Spare Board Kit	65
6.3.3	Remove the Original Set of Boards	65
6.3.4	Installing the Spare Board Kit	67
6.3.5	Installing the Beam Cosine Matrix	68
6.3.6	Testing the System	69
6.4	Troubleshooting a Beam Failure	70
6.5	Troubleshooting a Sensor Failure	70
6.5.1	Fault Log	71
6.6	Technical Support	71
6.7	H-ADCP Cables	72
6.8	Functional Description of H-ADCP Operation	74
6.8.1	Operating Modes	74
	Command Mode	74
	Ping Mode	74
6.8.2	Overview of Normal H-ADCP Operation	75
6.8.3	Functional Description of Operation	76
	Input Power	76
	Board Descriptions	76
	Sensors	77
7	Returning H-ADCPs to TRDI for Service	82
7.1	Domestic Shipments	82
7.2	International Shipments	84
8	Specifications	85
8.1	Outline Installation Drawings	88
9	Introduction to H-ADCP Commands	94
9.1	Data Communication and Command Format	94
9.1.1	Command Input Processing	95
9.1.2	Data Output Processing	95
9.2	Firmware Updates	96
9.3	Feature Upgrades	97
9.4	Using Direct Commands to Deploy your H-ADCP	99
9.5	Command Summary	100

10	Command Descriptions	105
	? – Help Menus	105
	Break	106
	Expert Mode	107
	OL - Features	108
10.1	Compass Commands	109
10.1.1	Available Compass Commands	109
10.1.2	Compass Command Descriptions	109
	AC – Output Active Calibration Data	109
	AD – Display Factory or Active Calibration Data	110
	AF – Field Calibrate Compass	111
	AR – Return to Factory Calibration	112
	AX – Examine Compass Calibration	112
	AZ – Zero Pressure Sensor	113
10.2	Bottom Track Commands	114
10.2.1	Available Bottom Track Commands	114
10.2.2	Bottom Track Command Descriptions	114
	BA - Evaluation Amplitude Minimum	114
	BB – High Bandwidth Maximum Depth	115
	BC - Correlation Magnitude Minimum	115
	BE - Error Velocity Maximum	115
	BF - Depth Guess	116
	BI - Gain Switch Depth	116
	BK – Water-Mass Layer Mode	117
	BL - Water-Mass Layer Parameters	117
	BM - Bottom Track Mode	118
	BP – Bottom-Track Pings per Ensemble	119
	BR - Resolution	120
	BS - Clear Distance Traveled	120
	BX – Maximum Tracking Depth	121
	BZ - Coherent Ambiguity Velocity	121
10.3	Control System Commands	122
10.3.1	Available Control System Commands	122
10.3.2	Control System Command Descriptions	122
	CB - Serial Port Control	122
	CF - Flow Control	124
	CK - Keep Parameters	124
	CL - Battery Saver Mode	125
	CM - Master	126
	CN - Save NVRAM to Recorder	126
	CP – Polled Mode	126
	CQ – Transmit Power	127
	CR – Retrieve Parameters	127
	CS – Start Pinging (Go)	128
	CY - Clear Error Status Word	128
	CZ – Power Down H-ADCP	130
10.4	Environmental Commands	131
10.4.1	Available Environmental Commands	131
10.4.2	Environmental Command Descriptions	131
	EA - Heading Alignment	131
	EB - Heading Bias	131
	EC - Speed of Sound	132
	ED - Depth of Transducer	132
	EH - Heading	133
	EP - Pitch (Tilt 1)	133
	ER - Roll (Tilt 2)	134
	ES – Salinity	134
	ET - Temperature	135
	EX – Coordinate Transformation	135
	EZ - Sensor Source	137
10.5	Fault Log Commands	138
10.5.1	Available Fault Log Commands	138

10.5.2	Fault Log Command Descriptions.....	138
	FC – Clear Fault Log.....	138
	FD – Display Fault Log	138
10.6	Performance and Testing Commands	139
10.6.1	Available Performance and Testing Commands.....	139
10.6.2	Performance and Testing Command Descriptions.....	139
	PA – Pre-deployment Tests	139
	PC – User-Interactive Built-In Tests.....	140
	PD - Data Stream Select.....	141
	PM - Distance Measurement Facility	142
	PS – Display System Parameters.....	142
	PT - Built-In Tests	144
	PT Test Results Error Codes	144
	PT0 - Help.....	145
	PT2 - Ancillary System Data	145
	PT3 - Receive Path.....	145
	PT4 - Transmit Path.....	147
	PT5 - Electronics Wrap Around.....	148
	PT6 - Receive Bandwidth.....	149
	PT7 - RSSI Bandwidth	149
10.7	Recorder Commands.....	151
10.7.1	Available Recorder Commands	151
	RA - Number of Deployments	151
	RB - Recorder Built-In Test.....	151
	RE – Erase Recorder.....	152
	RF – Recorder Free Space (Bytes).....	152
	RN – Set Deployment Name.....	152
	RR – Show Recorder File Directory	153
	RS - Recorder Free Space (Megabytes).....	153
	RY – Upload Recorder Files	154
10.8	Timing Commands.....	155
10.8.1	Available Timing Commands	155
10.8.2	Timing Command Descriptions.....	155
	TB - Time per Burst.....	155
	TC - Ensemble per Burst.....	156
	TE – Time per Ensemble	156
	TF – Time of First Ping	157
	TG – Time of First Ping (Y2k Compliant)	157
	TP – Time Between Pings.....	158
	TS – Set Real-Time Clock.....	159
	TT – Set Real-Time Clock (Y2k Compliant)	160
10.9	Water Profiling Commands.....	161
10.9.1	Standard Water Profiling Commands.....	161
	WA - False Target Threshold Maximum	161
	WB - Mode 1 Bandwidth Control.....	162
	WC - Low Correlation Threshold.....	162
	WD – Data Out.....	163
	WE - Error Velocity Threshold.....	163
	WF – Blank after Transmit	164
	WI - Clip Data Past Bottom	164
	WJ - Receiver Gain Select.....	165
	WL - Water Reference Layer	165
	WN – Number of Depth Cells.....	166
	WP – Pings Per Ensemble.....	166
	WQ - Sample Ambient Sound	166
	WS – Depth Cell Size	167
	WT - Transmit Length	167
	WU - Ping Weight	167
	WV – Ambiguity Velocity.....	168
	WW – Mode 1 Pings before Mode 4 Re-Acquire	169
	WY – Mode 1 Bandwidth	170

11	Advanced Commands	171
11.1	Sound Velocity Smart Sensor Commands	171
11.1.1	Available Sound Velocity Smart Sensor Command	171
11.1.2	Sound Velocity Smart Sensor Command Descriptions	171
	DB - RS-485 Port Control.....	171
	DS - Load SpeedOfSound with SVSS Sample (BIT Result)	171
	DW - Current ID on RS-485 Bus	172
	DX - Set SVSS to RAW Mode.....	172
	DY - Set SVSS to REAL Mode.....	173
	DZ - Get Single SCAN from SVSS.....	173
11.2	Waves Commands.....	174
11.2.1	Available Waves Commands	174
11.2.2	Waves Command Descriptions.....	174
	HA – Waves False Target Threshold	174
	HB – Automatically Chosen Bins for Wave Processing	174
	HD – Waves Data Out	175
	HF – Waves Flow Control	175
	HP – Waves Pings per Wave Record	176
	HR – Time Between Wave Records	176
	HS – Bins for Directional Wave Spectrum	177
	HT – Time Between Wave Record Pings.....	177
	HV – Bins for Velocity Spectrum	178
11.3	Ping Synchronization Commands	179
11.3.1	Available Ping Synchronization Commands.....	179
11.3.2	Ping Synchronization Command Descriptions	179
	SA - Synchronize Before/After Ping/Ensemble	179
	SB – Enable Channel B Breaks	180
	SI - Synchronization Interval	180
	SM - RDS3 Mode Select	181
	SS - RDS3 Sleep Mode	181
	ST - Slave Timeout	182
	SW - Synchronization Delay	183
11.3.3	Example Master/Slave Setup.....	183
	Master Slave Initialization	183
	Terminating Data Collection.....	184
	Example Wakeup Banners.....	185
12	Introduction to Output Data Format	186
12.1	Hexadecimal-ASCII Output Data	186
12.2	Binary Output Data Format	186
12.3	What Data Format Should I Use and Why?	187
13	PD0 Output Data Format	189
13.1	Header Data Format	191
13.2	Fixed Leader Data Format	193
13.3	Variable Leader Data Format.....	199
	How Does the H-ADCP Sample Depth and Pressure?	205
	Converting kpa to Depth	205
13.4	Velocity Data Format	206
13.5	Correlation Magnitude, Echo Intensity, and Percent-Good Data Format	208
13.6	Binary Bottom-Track Data Format	212
13.7	Binary Reserved BIT Data Format	217
13.8	Binary Checksum Data Format	217
14	Special Output Data Formats	218
14.1	DVL Binary Data Format (PD3).....	219
14.2	DVL Output Data Format (PD3) Details	221
14.3	DVL Binary Data Format (PD4/PD5).....	223
14.4	DVL Output Data Format (PD4/PD5) Details	225
14.5	DVL Binary Data Format (PD5).....	228
14.6	DVL Output Data Format (PD5) Details	230
14.7	DVL Output Data Format (PD6)	231
14.8	PD8 ASCII Output.....	233

14.9	H-ADCP Condensed 2D Output Format (PD14)	234
14.9.1	PD14 Format.....	234
14.9.2	PD14 Invalid Data	234
14.10	Output Data Format (PD16)	236
14.11	Output Data Format (PD18)	236
15	How to Decode an H-ADCP Ensemble	237
15.1	Rules for the BroadBand Data Format PD0	237
15.2	Recommended Data Decoding Sequence for BroadBand Data Format PD0	238
15.3	Pseudo-Code for Decoding PD0 Ensemble Data	238
15.4	Pseudo-Code for Decoding PD5 Ensemble Data	239
15.5	Example Code for Decoding BroadBand Ensembles.....	240
16	Firmware History	245

List of Figures

Figure 1.	300/600 kHz H-ADCP Overview.....	8
Figure 2.	300 kHz NB H-ADCP Overview.....	8
Figure 3.	H-ADCP Connections.....	9
Figure 4.	Installing the H-ADCP	11
Figure 5.	<i>SurfaceView</i> Deployment Screen.....	16
Figure 6.	<i>SurfaceView</i> Intensity Profile.....	16
Figure 7.	Barnacle Damage to Urethane Face	17
Figure 8.	Removing the I/O Cable	22
Figure 9.	300 kHz Narrow Beam Width H-ADCP Housing.....	24
Figure 10.	Housing Mounting Hardware	28
Figure 11.	300 kHz Narrow Beam Width Backup O-Ring Detail	31
Figure 12.	300 kHz NB Assembly – Two Piece Housing.....	32
Figure 13.	300 kHz NB Assembly – One Piece Housing	33
Figure 14.	Compass Alignment	38
Figure 15.	Communication Switch and Fuse	39
Figure 16.	PC Card Recorder.....	40
Figure 17.	Barnacle Damage	43
Figure 18.	Antifouling Paint Applied on two H-ADCPs.....	45
Figure 19.	Testing the H-ADCP	54
Figure 20.	Transmit Cable	66
Figure 21.	PC Board Connectors	66
Figure 22.	Ground Jumper	67
Figure 23.	Mounting Hardware.....	68
Figure 24.	I/O Cable Wiring.....	72
Figure 25.	Internal I/O Cable (Housing to PIO Board) Wiring	73
Figure 26.	RS232-to-RS422 Converter Wiring (25-Pin to 9-Pin)	73
Figure 27.	H-ADCP Wake-up and Timer Logic	79
Figure 28.	DC Power Path	80
Figure 29.	H-ADCP Block Diagram	81
Figure 30.	PC Board Locations	82
Figure 31.	Firmware Update.....	96
Figure 32.	RDIFlash Firmware Upgrade Utility Screen.....	97
Figure 33.	Installing Feature Upgrades	98
Figure 34.	Feature Upgrade Completed.....	98
Figure 35.	Software Break Setup in <i>WinRiver</i>	107
Figure 36.	Water-Mass Layer Processing	118
Figure 37.	H-ADCP Coordinate Transformation	136
Figure 38.	PT7 RSSI Bandwidth Test	150
Figure 39.	PD0 Standard Output Data Buffer Format.....	189
Figure 40.	Binary Header Data Format	191
Figure 41.	Fixed Leader Data Format	194

Figure 42.	Variable Leader Data Format	200
Figure 43.	Velocity Data Format.....	206
Figure 44.	Binary Correlation Magnitude, Echo Intensity, and Percent-Good Data Format	208
Figure 45.	Binary Bottom-Track Data Format.....	214
Figure 46.	Binary Reserved BIT Data Format	217
Figure 47.	Binary Checksum Data Format	217
Figure 48.	DVL Binary Data Format (PD3)	220
Figure 49.	DVL Binary Data Format (PD4/PD5)	224
Figure 50.	DVL Binary Data Format (PD5)	229

List of Tables

Table 1:	Toxic or Hazardous Substances and Elements Contained in Product	3
Table 2:	Horizontal Waves Upper Cutoff Frequency	14
Table 3:	Minimum Computer Hardware Requirements.....	19
Table 4:	300/600 kHz H-ADCP Replaceable Parts	49
Table 5:	300 kHz NB H-ADCPs Replaceable Parts.....	50
Table 6:	List of Least Replaceable Assemblies	57
Table 7:	Pre-deployment Test (PA) Possible Cause of Failures	64
Table 8:	Water Profiling.....	86
Table 9:	Long Range Mode.....	87
Table 10:	Profile Parameters	87
Table 11:	Echo Intensity Profile	87
Table 12:	Standard Sensors	87
Table 13:	Transducer and Hardware.....	88
Table 14:	Environmental	88
Table 15:	Power.....	88
Table 16:	Outline Installation Drawings.....	88
Table 17:	ADCP Minimum Required Commands for Deployments.....	99
Table 18:	H-ADCP Input Command Summary	100
Table 19:	H-ADCP Factory Defaults	103
Table 20:	Water-Mass Reference-Layer Modes	117
Table 21:	BM4/BM5 Minimum Tracking Depths	119
Table 22:	Serial Port Control.....	123
Table 23:	Baud Rate	123
Table 24:	Flow Control.....	124
Table 25:	Polled Mode Commands	127
Table 26:	Retrieve Parameters	128
Table 27:	Error Status Word	129
Table 28:	Coordinate Transformation Processing Flags.....	136
Table 29:	Sensor Source Switch Settings	137
Table 30:	Data Stream Selections.....	142
Table 31:	Error Code Hex to Binary Conversion	144
Table 32:	PT3 Failure	146
Table 33:	PT4 Failure	147
Table 34:	PT5 Results	148
Table 35:	PT6 Receive Bandwidth Nominal Values	149
Table 36:	Bandwidth Control.....	162
Table 37:	Ping Weights.....	168
Table 38:	WV-command Maximum Setting (20 Degree)	169
Table 39:	Waves Flow Control	176
Table 40:	Synchronization Parameters	179
Table 41:	Sleep Mode Parameters.....	182
Table 42:	Summary of Output Data Formats.....	188
Table 43:	Header Data Format	192
Table 44:	Fixed Leader Data Format	195

Table 45:	Variable Leader Data Format	201
Table 46:	Velocity Data Format.....	207
Table 47:	Correlation Magnitude Data Format	209
Table 48:	Echo Intensity Data Format.....	209
Table 49:	Percent-Good Data Format	211
Table 50:	Bottom-Track Data Format.....	215
Table 51:	Reserved for TRDI Format	217
Table 52:	Checksum Data Format	217
Table 53:	DVL Output Data Format (PD3) Details.....	221
Table 54:	DVL Output Data Format (PD4/PD5) Details.....	225
Table 55:	DVL Output Data Format (PD5) Details.....	230
Table 56:	DVL Output Data Format (PD6)	231
Table 57:	PD14 Output Data Format.....	235
Table 58:	Common Data Format IDs	237



WorkHorse H-ADCP Operation Manual

1 Introduction

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

1.1 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

14020 Stowe Drive
Poway, California 92064

Phone +1 (858) 842-2600

FAX +1 (858) 842-2822

Sales – rdisales@teledyne.com

Field Service – rdifs@teledyne.com

Teledyne RD Instruments Europe

2A Les Nertieres
5 Avenue Hector Pintus
06610 La Gaude, France

Phone +33(0) 492-110-930

FAX +33(0) 492-110-931

Sales – rdie@teledyne.com

Field Service – rdiefs@teledyne.com

Customer Service Administration – rdicsadmin@teledyne.com

Web: <http://www.rdinstruments.com>

24 Hour Emergency Support +1 (858) 842-2700

1.2 Notice of Compliance


1.2.1 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.


1.2.2 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 1.
--	---

1.2.3 WEEE

	<p>The mark shown to the left is in compliance with the Waste Electrical and Electronic Equipment Directive 2002/96/EC (WEEE).</p> <p>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 to one of the TRDI facilities below.</p> <table><tr><td>Teledyne RD Instruments USA 14020 Stowe Drive Poway, California 92064</td><td>Teledyne RD Instruments Europe 2A Les Nertieres 5 Avenue Hector Pintus 06610 La Gaude, France</td><td>Teledyne RD Technologies 1206 Holiday Inn Business Building 899 Dongfang Road, Pu Dong Shanghai 20122 China</td></tr></table>	Teledyne RD Instruments USA 14020 Stowe Drive Poway, California 92064	Teledyne RD Instruments Europe 2A Les Nertieres 5 Avenue Hector Pintus 06610 La Gaude, France	Teledyne RD Technologies 1206 Holiday Inn Business Building 899 Dongfang Road, Pu Dong Shanghai 20122 China
Teledyne RD Instruments USA 14020 Stowe Drive Poway, California 92064	Teledyne RD Instruments Europe 2A Les Nertieres 5 Avenue Hector Pintus 06610 La Gaude, France	Teledyne RD Technologies 1206 Holiday Inn Business Building 899 Dongfang Road, Pu Dong Shanghai 20122 China		

1.2.4 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 1: 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)
换能器配件 Transducer Assy.	X	O	O	O	O	O
接收机电路板 Receiver PCB	X	O	O	O	O	O
数据处理器电路板 DSP PCB	X	O	O	O	O	O
微处理器电路板 CPU PCB	X	O	O	O	O	O
输入输出电路板 PIO PCB	X	O	O	O	O	O
机体装配 Housing Assy.	X	O	O	O	O	O
底座装配 End-Cap Assy.	X	O	O	O	O	O
交流电转换器 AC Voltage Adapter	X	O	O	O	O	O
水下专用电缆 Underwater Cable	X	O	O	O	O	O
专用装运箱和泡沫塑料垫 Shipping Case w/Foam	O	O	O	O	O	O
<p>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.</p> <p>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.</p>						

1.3 Conventions Used in this Manual

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

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

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

```
[BREAK Wakeup B]
WorkHorse Horizontal Broadband H-ADCP Version 11.07
RD Instruments (c) 1996-2004
All Rights Reserved.
>
```

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



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



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

1.3.1 Abbreviations

The following abbreviations are used in this Operation Manual.

ADCP – Acoustic Doppler Current Profiler

H-ADCP – Horizontal Acoustic Doppler Current Profiler

WH – Workhorse

MSDS – Material Safety Data Sheet

1.4 Getting Started

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

The Operation Manual includes the following sections:

- **Introduction.** This section is an overview of the H-ADCP system.
- **Installation.** Use this section to plan your installation requirements. This section includes specifications and dimensions for the H-ADCP (including outline installation drawings).

- **Maintenance.** This section covers H-ADCP maintenance. Use this section to make sure the H-ADCP is ready for a deployment.
- **Test.** Use this section to test the H-ADCP.
- **Troubleshooting.** This section includes a system overview and how to troubleshoot the H-ADCP. If the H-ADCP fails a built-in test or you cannot communicate with the system, use this section to help locate the problem.
- **Commands and Output Data Format.** This section includes a reference for all commands and output data formats used by the H-ADCP.

The H-ADCP Quick Start Guide includes:

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

The Documentation CD includes:

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



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

1.5 H-ADCP Care

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

1.5.1 General Handling Guidelines

- Never set the transducer on a hard or rough surface. **The urethane faces may be damaged.**
- Always remove the retaining strap on the underwater-connect cable and dummy plug when disconnecting them. **Failure to do so will break the retainer strap.**
- Do not apply any upward force on the housing connector as the I/O cable is being disconnected. **Stressing the connector may cause the H-ADCP to flood.** Read the [Maintenance](#) section for details on disconnecting the I/O cable.
- Do not expose the transducer faces to prolonged sunlight. **The urethane faces may develop cracks.** Cover the transducer faces on the H-ADCP if it will be exposed to sunlight.

- Do not expose the I/O connector to prolonged sunlight. **The plastic may become brittle.** Cover the connector on the H-ADCP if it will be exposed to sunlight.
- Do not store the H-ADCP in temperatures over 60 degrees C. **The urethane faces may be damaged.**
- Vent the system before opening by loosening the hardware on the housing. If the H-ADCP flooded, there may be gas under pressure inside the housing.
- Do not scratch or damage the O-ring surfaces or grooves. **If scratches or damage exists, they may provide a leakage path and cause the H-ADCP to flood.** Do not risk a deployment with damaged O-ring surfaces.
- Do not lift or support an H-ADCP by the external I/O cable. **The connector or cable will break.**

1.5.2 Assembly Guidelines

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

1.5.3 Deployment Guidelines

- Read the Quick Start Guide and the Software User's Guides. These guides have step-by-step instructions to help you learn how to use the H-ADCP.
- Align the compass whenever the recorder module is replaced, or when any ferrous metals are relocated inside or around the H-ADCP housing. Ferro-magnetic materials affect the compass.
- The AC power adapter is not designed to withstand water. Use caution when using on decks in wet conditions.

- Avoid using ferro-magnetic materials in the mounting fixtures or near the H-ADCP. Ferro-magnetic materials affect the compass.

1.6 System Overview

The H-ADCP is designed to measure real-time horizontal current profiles from a permanent fixed mount. The H-ADCP system consists of an H-ADCP transducer with Standard Profiling modes, cables, and software. The input power requirements for the H-ADCP are +20 to 50 VDC. The H-ADCP system requires the addition of a Windows® compatible computer to collect data.

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

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

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

Housing– The standard housing allows deployment depths to 200 meters.

Thermistor – The Thermistor measures the water temperature.

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

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

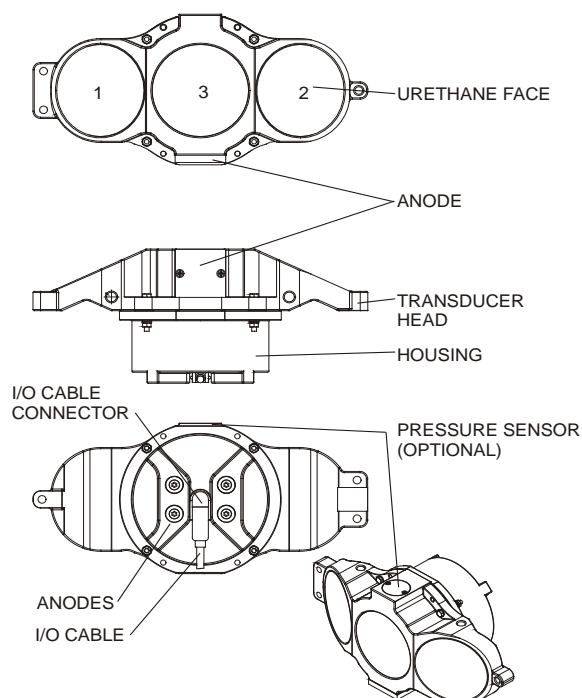


Figure 1. 300/600 kHz H-ADCP Overview

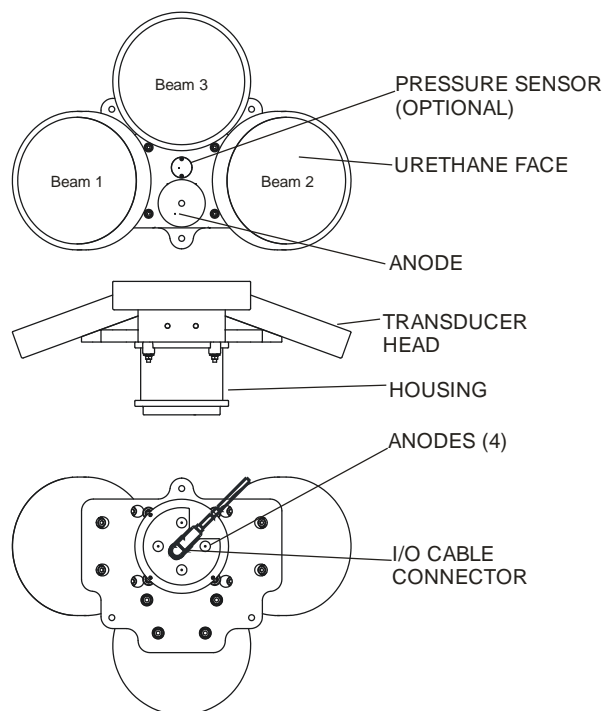


Figure 2. 300 kHz NB H-ADCP Overview

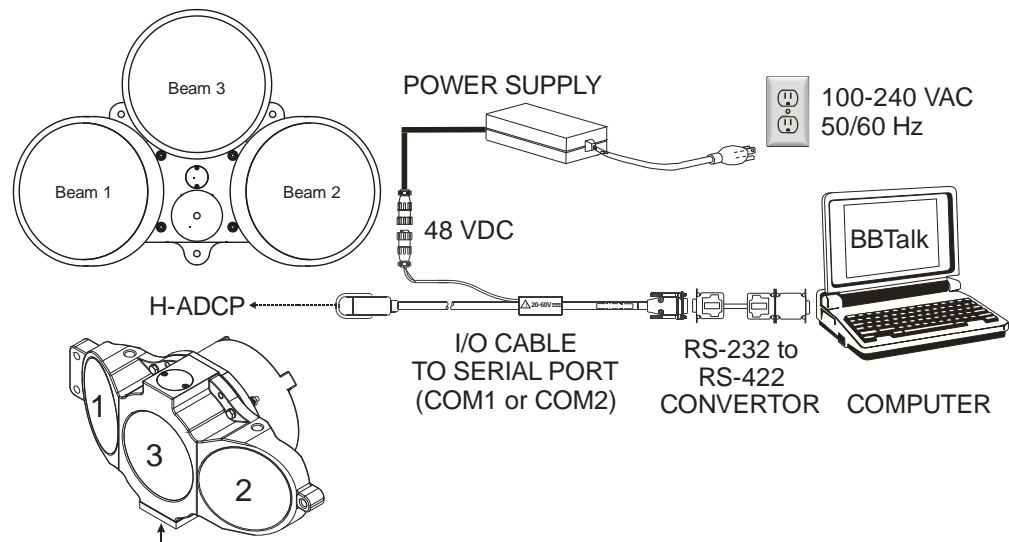


Figure 3. H-ADCP Connections

2 Installation

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

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

2.1 H-ADCP Orientation

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

- **X-Axis** - Pitch is measured around the X-axis and should be set to zero.
- **Y-Axis** - Roll is measured around the Y-axis and should be set to zero.
- **Pressure Sensor** – The pressure sensor must be facing up towards the water surface (for the 300 kHz NB H-ADCP, it is facing the beams – Beam 3 should be upward).

2.2 Attach H-ADCP to Structure

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

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

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



NOTE. TRDI offers optional kits for attaching the H-ADCP to a structure. For additional information, please contact our Field Service department (see [How to Contact Teledyne RD Instruments](#)).

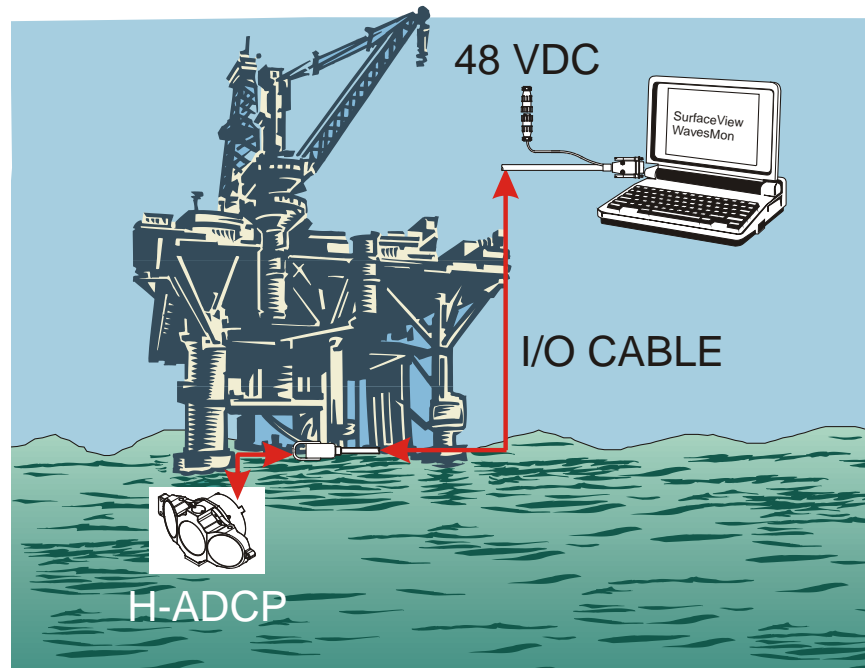


Figure 4. Installing the H-ADCP

2.3 H-ADCP Wave System Installation Checklist

✓ System Orientation

1. **Deploy the system pointed into the wave direction as much as possible.** If the system is in the shadow of the platform it may be challenging to profile outside of it.
2. **Waves from the side are acceptable, but not ideal.** Waves from the side can be measured; however the smallest measurable wave specification is different. Waves straight on might be measurable at 20 cm height, whereas waves from the side may need to be a minimum of 1.5m height.

✓ Obstructions

1. **Avoid obstructions in the beams.** Obstructions in the beams (fish, hardware, boats, thruster wash), may challenge the measurement. If the ADCP can get good profiles, it can produce both waves and currents results.
 - To avoid **fish** problems near the platform, choose range cells that are distant from the platform.
 - To avoid a **fixed obstruction**, choose range cells that are short of the obstruction.
 - Obstructing the beams close to the system makes collecting data impossible.

- The **bottom is a fixed obstruction** and one must choose range cells that are short of it if deployed in shallow water.
- The system is resilient to striking the **surface** at a grazing angle.
- A very large sea state will create wave troughs that block the beams if the deployment depth is too shallow.

✓ **Know Your Heading**

1. **Confirm that the ADCP heading is valid** (not simply pointing at the nearest large piece of steel.)
 - If the instrument heading is not correct, a fixed heading can be entered into the software if the platform heading is relatively fixed.
 - If the instrument heading is not correct and the platform can rotate to any orientation, then an externally measured heading must be applied.

✓ **Tilts** (constant angle not dynamics)

1. The **ideal tilt is angled slightly upward (2 to 5 degrees pitch)**.
2. A **level** deployment is **acceptable**.
3. **Use Caution if pitched slightly down:** this can place the measurement at great depth making it impossible to measure small or higher frequency waves.
4. **Pitch that is greater than 15 degrees is not recommended:** this scenario has not been tested.
5. The roll should be **zero** for **best measurements**. Roll less than 10 degrees is acceptable. **Use Caution if roll is greater than 10 degrees:** if cells in the right beam are too deep and cells in the left beam are too shallow the measurement may be compromised.

✓ **Deployment Depth**

1. The **ideal deployment depth** is approximately **10m submergence angled slightly upward (2 to 5 degrees pitch)** so that range cells at 100m are at about 3 to 5 meters submergence.
2. A large sea state will create wave troughs that block the beams if the deployment depth is too shallow: 6 meter waves will be a problem for a 3 meter deployment depth.
3. A very deep deployment depth will limit the wave frequencies and wave height that can be measured.

4. If a deep deployment is unavoidable, a greater tilt can be used but should not exceed about 15 degrees.
5. See Table 1, page 3 for the upper cutoff frequency.

✓ **Motion** (dynamics)

The best data is collected with the H-ADCP fixed in position: In many installations, such as when hanging over the side of a FPSO or Oil Platform, the H-ADCP will have motion as the vessel moves. This motion is typically coupled to the actual wave activity (and the vessel motion because of that): the result is that the quality of the H-ADCP waves measurement will be reduced. The default thresholds in *WavesMon* are set conservatively to avoid the biases from these motions. What follows are the motion limits that this conservative approach will work. Note that these motions assume that accelerations are minimal and the system moves slowly to the tilts and yaw angles indicated. You must make sure that your system will not move with high acceleration or tilts and yaw angles greater than what is specified below.

1. A fixed mounted system will perform better than a moving one. The system must pitch, roll, and yaw with the waves **less than ± 10 degrees**. The performance with frequency and minimum wave height has been de-rated for these kinds of dynamics.
2. **Pitch is the most damaging** of the types of motion. Pitch causes the depth of the range cells to move up and down in partially correlated fashion with the waves. The consequence of dynamic pitching is that the highest usable frequency will be reduced (0.2 Hz rather than 0.5Hz at 10m deployment depth).
3. **Roll** is less of a problem than pitch but still de-rates the performance.
4. **Yaw** at wave frequencies causes the directional distribution to be smeared but is not a serious problem to wave parameters. If the system is rotating (>45 degrees in 17 minutes) then expect the wave direction to be biased accordingly.

✓ **Platform Influence**

1. Floating platforms like drill ships will influence waves near the platform.
 - Long period waves will move the platform (heave): the pressure sensor cannot be used as a reference because it will not see the long period waves.
 - Shorter period waves will reflect off the platform causing wave energy at these frequencies to be exaggerated.

- **It is best to select range cells that are distant from the platform (60-100m)** because the platform will reflect high frequency waves and move with low frequency waves. The H-ADCP can accurately measure both long and short waves, in the vicinity and far away from the platform. Other instrumentation (such as pressure sensor, or surface tracker) attached to the platform, will not be able to accurately measure the waves because the platform partially moves with the longer period waves and reflects shorter period waves. Because the H-ADCP can profile a range of cells distant from the platform and because it exclusively measures the horizontal component of the waves, the H-ADCP can resolve the real wave environment.
- **Set the small wave screening frequency to 0.03 Hz if the platform is heaving with the waves.** This keeps the processing from using the pressure sensor data at wave band frequencies since we know the pressure sensor is not accurate if it moves with the waves.

✓ **Highest Usable Frequency**

1. If for any reason, wave direction, wave height, or wave period seems unrealistic, try setting the upper cutoff frequency to a more conservative setting (lower frequency).

Table 2: Horizontal Waves Upper Cutoff Frequency

Depth (meters)	8 Meter Bins		4 Meter Bins	
	Frequency	Period	Frequency	Period
5	0.35	2.86	0.32	3.13
10	0.22	4.55	0.195	5.13
20	0.13	7.69	0.12	8.33
40	0.086	11.63	0.078	12.82

✓ **Default Settings**

1. 2Hz data is essential. Set the Baud Rate to ensure that data transfer can keep up with moving whole ensembles at 2Hz.
2. Collect data in **Broadband** mode.
3. Choose **8 meter bins**: 4 meters will work, but 8 meter bins are quieter.
4. Unless the platform rotation rate is significant, collect 4096 samples per burst continuously. If the rotation is important, then collect 2048.

5. The upper cutoff frequency default is 0.2Hz (5 second period waves). While we can often out perform this, it is a setting that will work across a wide range of deployment conditions and environments.
6. You must collect data using **Beam Coordinates** in order to calculate waves data.

2.4 Testing the Installed H-ADCP

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

- a. Start *SurfaceView*.
- b. On the **Setup Wizard**, click **Real-Time**. Click **Next**.
- c. Once communications is established, on the **Communications Settings** screen, click **Next**.
- d. Accept the default setting on the next several screens. Click **Finish**.

Pitch and Roll Adjustment

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

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



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

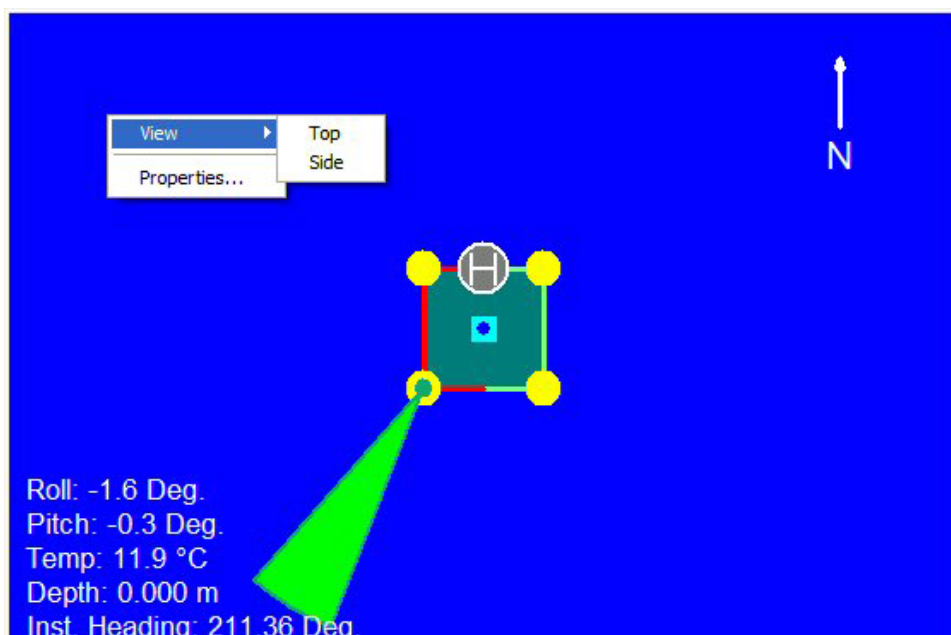


Figure 5. SurfaceView Deployment Screen

Intensity Plot

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

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

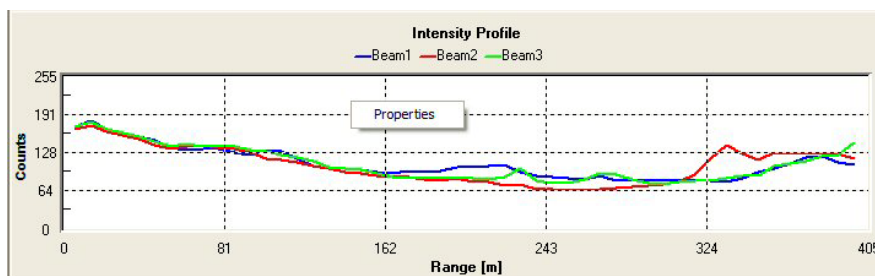


Figure 6. SurfaceView Intensity Profile

2.5 Periodic Maintenance

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

Objects deployed within about 100 meters (328 feet) of the surface are subject to the buildup of organic sea life (biofouling). Soft-bodied organisms usually cause no problems, but hard barnacle shells can cut through the urethane transducer face causing transducer failure and leakage into the H-ADCP (see Figure 7).



Figure 7. Barnacle Damage to Urethane Face

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

Some of our users have had success applying a thin coat (≈ 4 mm; ≈ 0.16 in.) of either a 50:50 mix of chili powder and Vaseline or chili powder and silicone grease to the transducer faces. The chili powder should be the hottest that can be found. Water flowing across the transducers will wash this mix away over time. The silicone mixture tends to last longer.

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

The other method is to use antifoulant paint. At present, we recommend the following antifouling paint manufacturer and paint brand: Courtaldis Finish-

es Interlux brand paints, US Telephone: +1 (908) 686-1300, Web Page: www.interlux.com.

CAUTION.



1. Read the Material Safety Data Sheet before using any of the listed solvents and paints.
2. Some antifouling coatings may not be legal for use in all areas. Check with your local environmental agency before using the antifouling paint.
3. Do not arbitrarily use antifouling paints. Be aware that antifouling paints can accelerate the dezincification corrosion of brass. Once initiated, dezincification will rapidly destroy the brass.
4. TRDI no longer recommends the use of Nopocide for the prevention of biofouling. If using antifouling grease, remove it immediately after recovering the H-ADCP.
5. Antifouling grease is toxic. Read the product safety data sheet before using the grease. Wear gloves and a face shield when applying the grease. If the skin comes in contact with the grease, immediately wash the affected area with warm, soapy water.
6. When possible, do not coat the transducer faces with cuprous oxide or related paints that contain chemicals such as copper, chrome, or arsenic. These paints advance the corrosion of the transducer assembly and will cause the urethane to separate from the transducer cups.
7. All US Coastal States prohibit the use of tributyl-tins on boat hulls. The European Economic Commission has released a draft directive that would prohibit the use of many organo-tins after July 1989. We strongly recommend you obey your local laws.

2.6 Cabling Considerations

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

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

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

2.7 Computer Considerations

We designed the H-ADCP to use a Windows® compatible computer. The computer controls the H-ADCP and displays its data, usually through our *SurfaceView* and *SurfaceWaves* programs. Table 3 lists the minimum computer requirements.



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

Table 3: Minimum Computer Hardware Requirements

Windows XP® or Windows 2000®
Pentium III 600 MHz class PC (higher recommended)
64 megabytes of RAM (128 MB RAM recommended)
50 MB Free Disk Space plus space for data files (A large, fast hard disk is recommended)
One Serial Port (two or more High Speed UART Serial Port recommended)
Minimum display resolution of 1024 x 768, 256 color (higher recommended)
CD-ROM Drive
Mouse or other pointing device

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

However, with experience we can recommend that:

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

2.8 Power Considerations

H-ADCPs require an input voltage of 20 to 50 VDC. The transmit power depends on the input voltage.



NOTE. The transmitted power decreases by 1 dB if the input voltage drops from 42 VDC to 33 VDC. For a 300 kHz H-ADCP, one dB is about one depth cell.

The power supply must be able to handle the inrush current as well. Inrush current is the current required to fully charge up the capacitors when power

is applied to the H-ADCP. The capacitors provide a store of energy for use during transmit. The inrush current is as high as 3 Amps rms. The H-ADCP will draw this amperage until its capacitors are fully charged.

If the power supply limits the current or the power drop on the cable is significant, then the power on cycle will take longer. It can take up to one minute. You do not want the power to shut down during the inrush current draw, as this may not allow the H-ADCP electronics to start.

AC Power Supply

The AC power supplies provided by TRDI with the system are designed to maintain a 400-ma supply under this load. They are 75-Watt supplies, with 48 VDC, 1.5 amp outputs. They will not fall back to 0 amps, 0 volts under a load. Customer provided power supplies might shut themselves down under such a load; when that occurs, the H-ADCP will not wakeup.

2.9 12 VDC Power Considerations

Some special-order H-ADCP's (red end-cap) are 12 Volt systems. The input voltage is from 10.5 to 18.0 VDC.

3 Maintenance

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

[Replaceable Parts](#) lists the items in the tools and spares parts kits. Use these kits when doing routine H-ADCP maintenance.



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

3.1 I/O Cable and Dummy Plug

The underwater connector (on the housing) and the I/O cable and dummy plug are molded wet-mate connectors. The connector is a factory-installed item. We do not recommend removing it for any routine maintenance.



NOTE. The dummy plug should be installed any time the I/O cable is removed. Use the dummy plug when the H-ADCP is in storage or is being handled.

The cable should be disconnected with a straight outward motion only. Use the following procedure to disconnect the cable.



CAUTION. When disconnecting the H-ADCP I/O cable, do not apply any upward force on the connector as it is being pulled off. Applying an upward angle as the cable is disconnected puts stress on the connector. This may cause several serious problems:

- a) The connector or connector pins can crack.
- b) The O-ring on the bottom of the connector can be damaged.
- c) The molded urethane on the connector may separate from the brass insert.

If the connector is damaged in any of these ways, your H-ADCP will flood.

Disconnecting the Cable

- a. Release the retaining strap by pulling it over the connector.
- b. Grasp the cable close to the housing (see Figure 8). Your thumb should rest on top of the connector or against the edge of the housing. *Do not try to fit your hand under the cable as it passes over the housing.* This is what causes the upward force!
- c. Pull the cable straight out away from the housing with a gentle rocking motion. Do not apply any upward force on the connector as it is being disconnected.

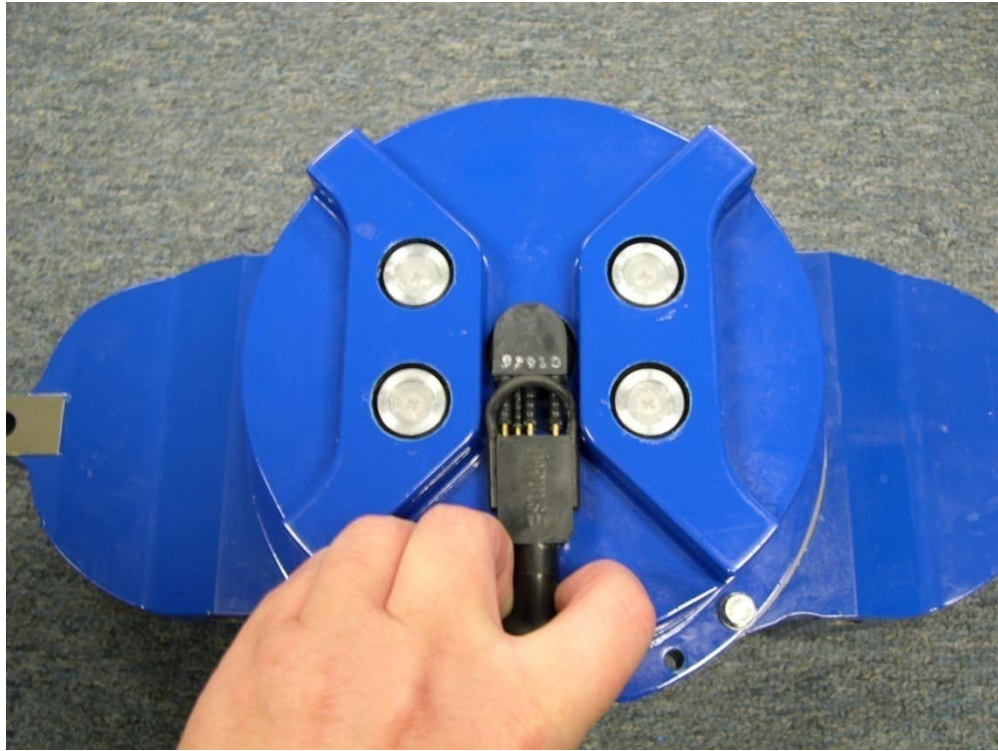


Figure 8. Removing the I/O Cable

Connecting the Cable

- a. Apply a light coat of DC-111 lubricant to the rubber portion of the connector pins. This will help seat the connector.
- b. Gently push the cable straight in toward the connector. Do not apply any upward force on the connector as it is being connected.
- c. Roll the retaining strap over the connector.

3.2 H-ADCP Disassembly

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

3.2.1 Housing Removal Procedures – 300/600 kHz H-ADCPs

To remove the housing, do the following steps.



NOTE. For 300 kHz Narrow Beam Width H-ADCPs, please use **Housing Removal Procedures – 300 NB kHz H-ADCPs**.

- a. Dry the outside of the H-ADCP.
- b. Stand the H-ADCP on its transducer face on a soft pad.
- c. Remove all power to the H-ADCP.

- d. Remove the I/O cable and place the dummy plug on the I/O cable connector (see [I/O Cable and Dummy Plug](#)).
- e. Loosen (do not remove) the four housing bolts to vent the system.
- f. Once all four housing bolts (6-mm) have been loosened, remove the bolts from the housing.



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

- g. Carefully pull the housing away from the transducer until you can gain access to the connector jack on the common mode choke. Use care; the plastic mating surfaces scratch easily. Do not damage the mating surfaces.
- h. Squeeze the sides of the internal I/O cable connector to release it from the common mode choke jack. Set the housing aside.
- i. Clean the O-ring mating surfaces with a soft, lint-free cloth. Inspect the surfaces for damage (see [O-ring Inspection and Replacement](#)). Even small scratches can cause leakage around the O-ring seal.

3.2.2 Housing Removal Procedures – 300 NB kHz H-ADCPs

The 300 kHz Narrow Beam Width H-ADCP uses either a one-piece or two-piece housing. For the one-piece housing, follow [300 kHz Narrow Beam Width Transducer Head Assembly Removal](#).



NOTE. When you need access to the electronics, TRDI recommends removing the transducer head assembly (see [300 kHz Narrow Beam Width Transducer Head Assembly Removal](#)).



Figure 9. 300 kHz Narrow Beam Width H-ADCP Housing

300 kHz Narrow Beam Width End-Cap Removal Procedures

To remove the end-cap, do the following steps.

- a. Dry the outside of the H-ADCP.
- b. Stand the H-ADCP on its transducer face on a soft pad.
- c. Remove all power to the H-ADCP.
- d. Remove the I/O cable and place the dummy plug on the I/O cable connector (see [I/O Cable and Dummy Plug](#)).
- e. Loosen (do not remove) the four end-cap bolts to vent the system.
- f. Once all four end-cap bolts (6-mm) have been loosened, remove the bolts from the end-cap.



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

- g. Carefully pull the end-cap away from the housing until you can gain access to the connector jack on the common mode choke. Use care; the

plastic mating surfaces scratch easily. Do not damage the mating surfaces.

- h. Squeeze the sides of the internal I/O cable connector to release it from the common mode choke jack. Set the end-cap aside.
- i. Remove any water from the end-cap O-ring grooves with a soft, lint-free cloth. Clean the O-ring mating surfaces. Inspect the surfaces for damage. Even small scratches can cause leakage around the O-ring seal.

300 kHz Narrow Beam Width Transducer Head Assembly Removal

- a. Remove all power to the H-ADCP.
- b. Remove the I/O cable and place the dummy plug on the I/O cable connector (see [I/O Cable and Dummy Plug](#)).
- c. Stand the H-ADCP on its end-cap.
- d. Loosen (do not remove) the four bolts (8-mm) that attach the housing flange to the transducer head assembly to vent the system.
- e. Once all four bolts (8-mm) have been loosened, remove the bolts.
- f. Carefully lift the transducer assembly straight up and away from the housing until you can gain access to the connector jack on the common mode choke. Use care; the plastic mating surfaces scratch easily. Do not damage the mating surfaces.



NOTE. The cable attached to the end cap is only long enough to disconnect the internal I/O cable. There is NOT enough cable to set the transducer down next to the Housing Assembly.

- g. Squeeze the sides of the internal I/O cable connector to release it from the common mode choke jack. Set the end-cap assembly aside. Set the transducer assembly (transducer face down) on a soft pad.
- h. Clean the O-ring mating surfaces with a soft, lint-free cloth. Inspect the surfaces for damage.
- i. When you are ready to re-assemble the H-ADCP, see [300 kHz Narrow Beam Width Transducer Head Replacement](#).

3.3 H-ADCP Re-assembly

To replace the housing, proceed as follows.

- a. If you are sealing the H-ADCP for a deployment, be sure you have done all appropriate maintenance items (see [Sealing the H-ADCP for a Deployment](#)).
- b. Make sure all printed circuit boards, spacers, cables, and screws have been installed.

- c. Install two fresh bags of desiccant just before closing the H-ADCP (see [Desiccant Bags](#)).

3.3.1 O-ring Inspection and Replacement

This section explains how to inspect/replace the H-ADCP O-rings. A successful deployment depends on the condition of two O-rings and their retaining grooves. Read all instructions before doing the required actions.

300 and 600 kHz H-ADCPs

- Transducer assembly, face, 2-260

300 kHz Narrow Beam Width H-ADCP

- Transducer assembly, face, 2-260
- Transducer assembly, bore , 2-258
- Transducer assembly, par-bak 8-258



NOTE. The backup O-ring is installed on 300 kHz Narrow Beam Width systems in addition to the 2-258 bore O-ring on the transducer head assembly. Install the backup O-ring with the cupped side facing the 2-258 bore seal O-ring.

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



NOTE. We recommend you use new O-rings if you are preparing for a deployment.

- a. Inspect the O-rings. When viewed with an unaided eye, the O-rings must be free of cuts, indentations, abrasions, foreign matter, and flow marks. The O-ring must be smooth and uniform in appearance. Defects must be less than 0.1 mm (0.004 in.).



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

- b. Clean and inspect the O-ring grooves. Be sure the grooves are free of foreign matter, scratches, indentations, corrosion, and pitting. Run your fingernail across damaged areas. If you cannot feel the defect, the damage may be minor; otherwise, the damage may need repair.



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

- c. If a scratch is on the plastic housing flange O-ring groove, it may be gently sanded using 600-grit (wet) sandpaper. Use care not to cause further damage.

- d. Lubricate the O-ring with a thin coat of DC-111 lubricant (see [Replaceable Parts](#)). Apply the lubricant using latex gloves. Do not let loose fibers or lint stick to the O-ring. Fibers can provide a leakage path.
- e. The backup O-ring (see Figure 11 and Figure 12) is installed in addition to the 2-258 bore O-ring on the transducer head assembly for 300 kHz Narrow Beam Width systems only. Install the backup O-ring with the cupped side facing the 2-258 bore seal O-ring.



NOTE. TRDI uses Dow Corning's silicone lube model number 111 but any type of silicone O-ring lube can be used.



CAUTION. Apply a **very thin** coat of silicone lube on the O-ring. Using too much silicone lube on the O-ring can be more harmful than using no O-ring lube at all.

3.3.2 Housing Replacement

To replace the housing, do the following steps.



NOTE. For 300 kHz Narrow Beam Width H-ADCPs, please use **300 kHz Narrow Beam Width End-Cap Replacement**.

- a. Stand the H-ADCP on its transducer face on a soft pad.
- b. Inspect, clean, and lubricate the O-ring on the housing (see [O-ring Inspection and Replacement](#)). Apply a very thin coat of silicone lube on the O-ring.



NOTE. We recommend you use new O-rings if you are preparing for a deployment.



NOTE. TRDI uses Dow Corning's silicone lube model number 111 but any type of silicone O-ring lube can be used.



CAUTION. Apply a **very thin** coat of silicone lube on the O-ring. Using too much silicone lube on the O-ring can be more harmful than using no O-ring lube at all.

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



CAUTION. Check that no wires or any other object is pinched between the housing and the transducer. Use rubber bands to hold the wiring in place as necessary. **If the O-ring is not in the groove or if a wire or other object is pinched, the H-ADCP will flood.**

- e. Examine the housing assembly nuts, bolts, and washers (6-mm) for corrosion; replace if necessary. Figure 12 shows the assembly order of the mounting hardware. All the hardware items are needed to seal the H-ADCP properly.
- f. Install all four sets of hardware until “finger-tight.”
- g. Tighten the bolts in small increments in a “cross” pattern until the split washer flattens out, and then tighten each bolt ¼ turn more to compress the face seal O-ring evenly. Tighten the bolts to the recommended torque value of 5.6 Newton-meters (50 pound-inches).



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



CAUTION. Do not over tighten the bolts that hold the transducer and housing together. If you tighten too far, you can crack or break the housing. On the other hand, leaving the bolts too loose can cause the system to flood. **Tighten the hardware to the recommended torque value.**



NOTE. The recommended torque value for the housing 6-mm bolts is 5.6 Newton-meters (50 pound-inches).

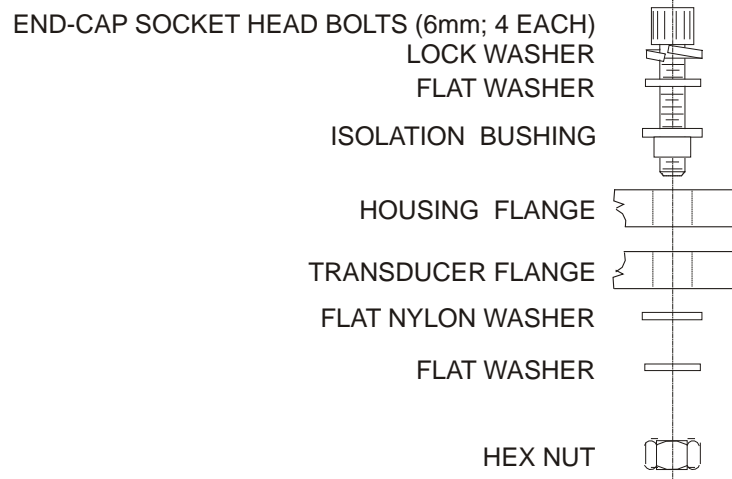


Figure 10. Housing Mounting Hardware

300 kHz Narrow Beam Width End-Cap Replacement

- a. Stand the H-ADCP on its transducer face on a soft pad.
- b. Inspect, clean, and lubricate the face and bore O-rings on the end-cap.
Apply a very thin coat of silicone lube on the O-rings.



NOTE. We recommend you use new O-rings if you are preparing for a deployment.



NOTE. TRDI uses Dow Corning's silicone lube model number 111 but any type of silicone O-ring lube can be used.



CAUTION. Apply a **very thin** coat of silicone lube on the O-ring. Using too much silicone lube on the O-ring can be more harmful than using no O-ring lube at all.

- c. Connect the internal I/O connector to the plug on the common mode choke.
- d. Place the end-cap on the housing, aligning the mating holes and the beam 3 number embossed on the end-cap with the beam 3 number embossed on the transducer head. When mating the end-cap with the housing flange, try to apply equal pressure to all parts of the O-rings. Make sure the face and bore O-rings remain in the retaining groove.



CAUTION. Check that no wires or any other object is pinched between the end-cap and the housing. Use rubber bands to hold the wiring in place as necessary. **If the O-ring is not in the groove or if a wire or other object is pinched, the H-ADCP will flood.**

- e. Examine the end-cap assembly nuts, bolts, and washers (6 mm) for corrosion; replace if necessary. Figure 10 shows the assembly order of the end-cap mounting hardware. All the hardware items are needed to seal the H-ADCP properly.
- f. Install all four sets of hardware until “finger-tight.”
- g. Tighten the bolts in small increments in a “cross” pattern until the split washer flattens out, and then tighten each bolt ¼ turn more to compress the face seal O-ring evenly. Tighten the bolts to the recommended torque value of 5.6 Newton-meters (50 pound-inches).



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



CAUTION. Do not over tighten the bolts that hold the transducer, housing, and end cap together. If you tighten too far, you can crack or break the plastic bushing. On the other hand, leaving the bolts too loose can cause the system to flood. **Tighten the hardware to the recommended torque value.**



NOTE. The recommended torque value for the end-cap 6-mm bolts is 5.6 Newton-meters (50 pound-inches).

300 kHz Narrow Beam Width Transducer Head Replacement

- a. Stand the H-ADCP on its end-cap.
- b. Inspect, clean, and lubricate the O-rings on the transducer head flange. Apply a very thin coat of silicone lube on the O-ring.



NOTE. We recommend you use new O-rings if you are preparing for a deployment.



NOTE. TRDI uses Dow Corning's silicone lube model number 111 but any type of silicone O-ring lube can be used.



CAUTION. Apply a **very thin** coat of silicone lube on the O-ring. Using too much silicone lube on the O-ring can be more harmful than using no O-ring lube at all.

- c. Connect the internal I/O connector to the plug on the common mode choke.
- d. Gently lower the transducer head/electronics assembly into the housing, aligning the mating holes and the beam 3 number embossed on the transducer head with the beam 3 number embossed on the end-cap. When mating the housing with the transducer head flange try to apply equal pressure to all parts of the O-rings. Make sure the face and bore O-rings remain in the retaining groove.



CAUTION. Check that no wires or any other object is pinched between the transducer head and the housing. Use rubber bands to hold the wiring in place as necessary. **If the O-ring is not in the groove or if a wire or other object is pinched, the H-ADCP will flood.**

- e. Examine the transducer assembly nuts, bolts, and washers (8-mm) for corrosion; replace if necessary. The figure below shows the assembly order of the transducer mounting hardware. All hardware items are needed to seal the H-ADCP properly.
- f. Install all four sets of hardware until "finger tight."

- g. Tighten the bolts in small increments in a “cross” pattern until the split washer flattens out, and then tighten each bolt $\frac{1}{4}$ turn more to compress the face seal O-ring evenly. Tighten the bolts to the recommended torque value of 9.6 Newton-meters (85 pound-inches). Do not deform the plastic bushings.



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



CAUTION. Do not over tighten the bolts that hold the transducer, housing, and end cap together. If you tighten too far, you can crack or break the plastic bushing. On the other hand, leaving the bolts too loose can cause the system to flood. **Tighten the hardware to the recommended torque value.**



NOTE. The recommended torque value for the transducer head 8-mm bolts is 9.6 Newton-meters (85 pound-inches).

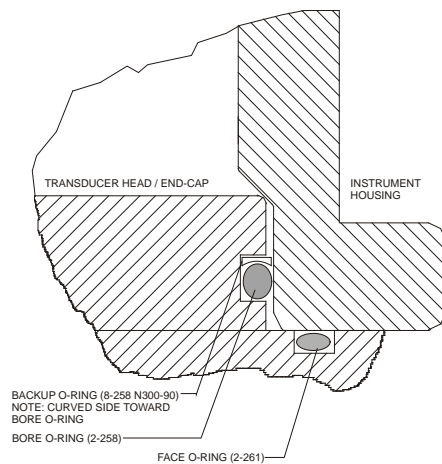


Figure 11. 300 kHz Narrow Beam Width Backup O-Ring Detail

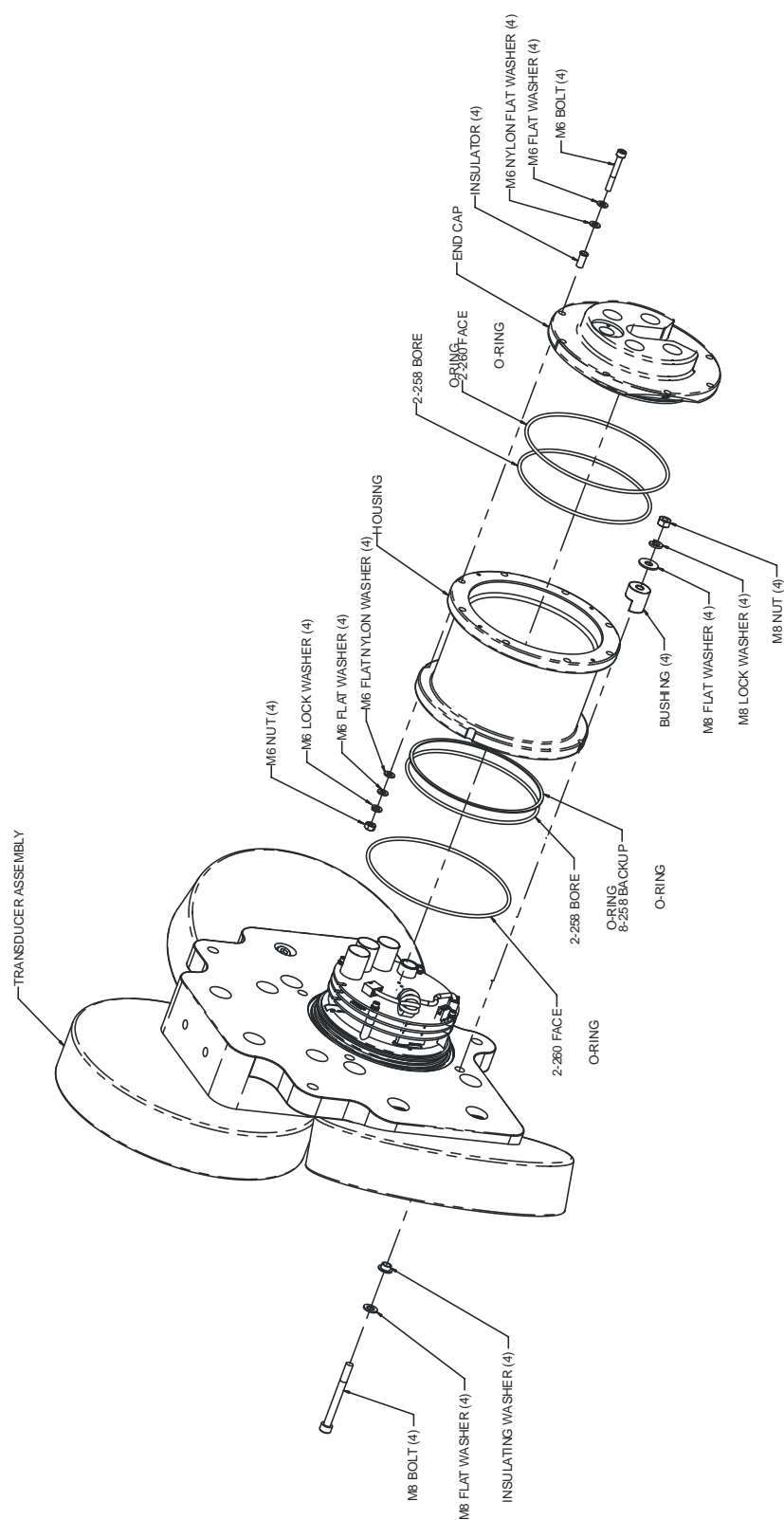


Figure 12. 300 kHz NB Assembly – Two Piece Housing

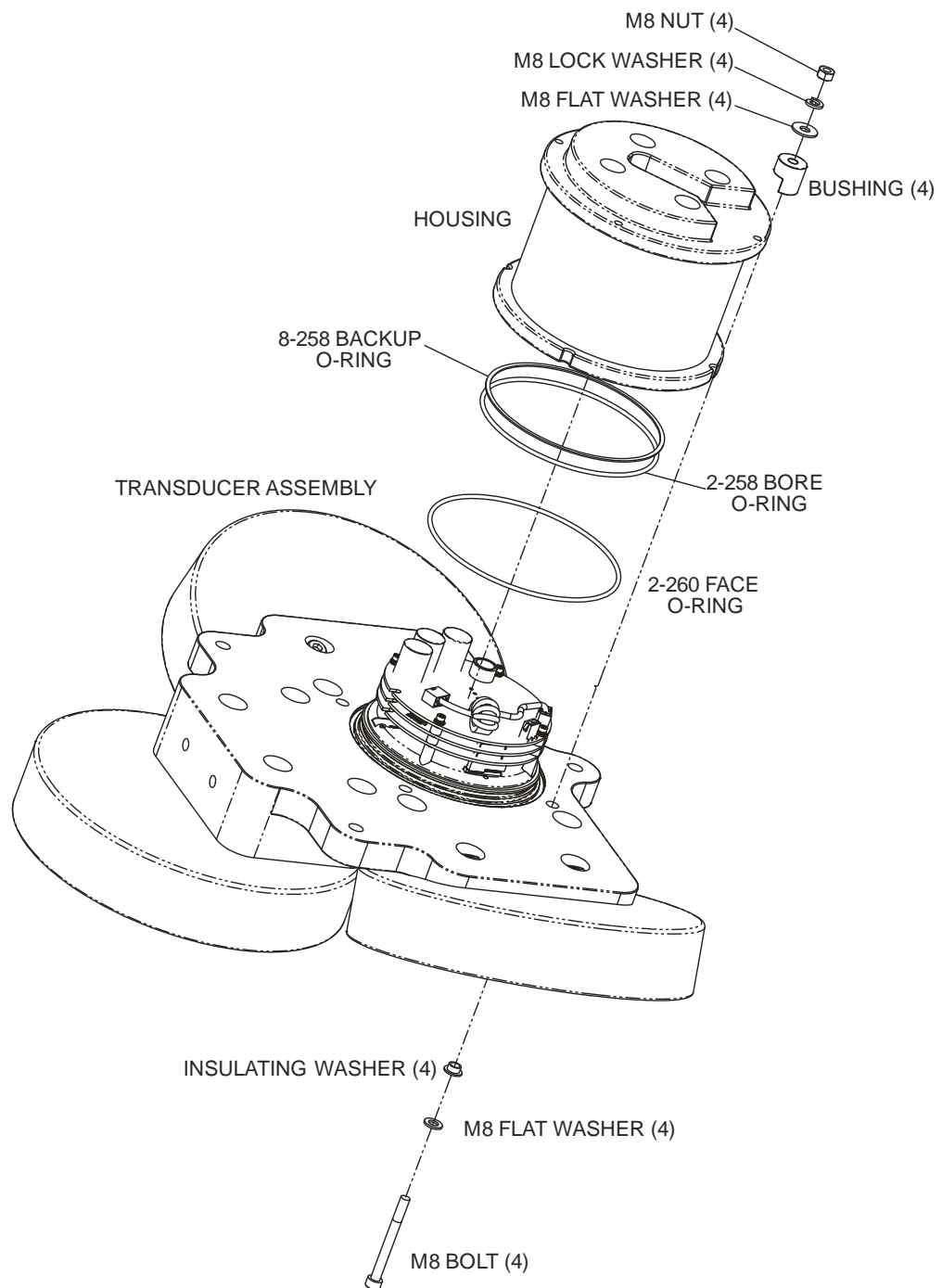


Figure 13. 300 kHz NB Assembly – One Piece Housing

3.4 Zinc Anode Inspection and Replacement

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

3.4.1 Zinc Anode Inspection

The life of a zinc anode is not predictable. An anode may last as long as one year, but dynamic sea conditions may reduce its life. Use a six-month period as a guide. If the total deployment time for the anodes has been six months or more, replace the anodes. If you expect the next deployment to last six months or more, replace the anodes. Inspect the anodes as follows.

- a. Inspect the anodes on the transducer assembly and housing for corrosion and pitting. If most of an anode still exists, you may not want to replace it.
- b. Inspect the RTV-covered screws that fasten each anode. If the RTV has decayed enough to let water enter between the screws and the anode, replace the RTV.
- c. If you have doubts about the condition of the anodes, remove and replace the anode.

3.4.2 Zinc Anode Electrical Continuity Check

Check electrical continuity using a Digital Multimeter (DMM). All measurements must be less than five ohms. If not, reinstall the affected anode.

Housing Anodes. Measure the resistance between all four anodes. Scratch the surface of the anode with the DMM probe to make good contact if the anode is oxidized. The resistance should be less than five ohms.

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

3.4.3 Zinc Anode Replacement

The following steps explain how to remove and replace the zinc anode/s.

- a. Remove the RTV from the anode screw heads. Remove the screws.
- b. The anode may stick to the H-ADCP because of the RTV used during assembly. To break this bond, first place a block of wood on the edge of the anode to protect the housing anodizing and paint. Carefully strike the block to loosen the anode.
- c. Clean the bonding area under the anode. Remove all foreign matter and corrosion. Apply a continuous 1-2 mm bead (0.04-0.08 in.) of RTV around each screw hole.
- d. Set a new anode in place and fasten with new screws.
- e. Fill the counter bore above each screw head with RTV. The RTV protects the screw heads from water and prevents breaking the electrical continuity between the anode, screw, and housing.
- f. Check electrical continuity. If any measurement is greater than one ohm, reinstall the affected anode.

CAUTION.



1. Do not use zinc anodes with an iron content of more than 0.0015%. The major factor controlling the electrical current output characteristics of zinc in seawater is the corrosion film that forms on the surface of the zinc. Corrosion product films containing iron have a high electrical resistance. As little as 0.002% iron in zinc anodes degrades the performance of the anode.
2. Do not use magnesium anodes. Magnesium rapidly corrodes the aluminum housing.
3. Do not connect other metal to the H-ADCP. Other metals may cause corrosion damage. Use isolating bushings when mounting the H-ADCP to a metal structure.

3.5 Compass Calibration

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

- We recommend against calibrating the H-ADCP while on a ship/rig. The ship's motion and magnetic fields from the hull and engine will likely prevent successful calibration.
- If you think your mounting fixture or frame has some magnetic field or magnetic permeability, calibrate the H-ADCP inside the fixture. Depending on the strength and complexity of the fixture's field, the calibration procedure may be able to correct it.

3.5.1 Preparing for Calibration

- a. Place the H-ADCP on a piece of strong cardboard on top of a smooth wooden (non-magnetic) table. If a wooden table is not available, place the unit on the floor as far away from metal objects as possible. Use the cardboard to rotate the H-ADCP during calibration—this way you will not scratch the H-ADCP.
- b. Connect the H-ADCP as shown in the Quick Start Guide.
- c. Start *BBTalk*. See the TRDI Tools User's Guide for assistance on using *BBTalk*.

3.5.2 Compass Calibration Verification

Compass calibration verification is an automated built-in test that measures how well the compass is calibrated. The procedure measures compass parameters at every 5° of rotation for a full 360° rotation. When it has collected data for all required directions, the H-ADCP computes and displays the results.



NOTE. Verify the compass if you have just replaced the memory module or any ferrous metals is relocated inside or around the H-ADCP housing.

- a. Prepare the H-ADCP for calibration (see [Preparing for Calibration](#)).
- b. Using *BBTalk*, send a Break to wake up the H-ADCP.
- c. At the > prompt, type AX and press return.
- d. When prompted, rotate the H-ADCP smoothly and slowly 360 degrees (approximately 5 degrees per second). Pay particular attention to the Overall Error. For example;

>AX

↓

HEADING ERROR ESTIMATE FOR THE CURRENT COMPASS CALIBRATION:

OVERALL ERROR:

Peak Double + Single Cycle Error (should be < 5()): (1.55(

DETAILED ERROR SUMMARY:

Single Cycle Error: (1.54(

Double Cycle Error: (0.07(

Largest Double plus Single Cycle Error: (1.61(

RMS of 3rd Order and Higher + Random Error: (0.31(

If the overall error is less than 5°, the compass does not require alignment. You can align the compass to reduce the overall error even more (if desired).

3.5.3 Compass Calibration Procedure

The built-in automated compass calibration procedure is similar to the alignment verification. The H-ADCP uses the first rotation(s) to compute a new calibration matrix and the final rotation to verify the calibration. It will not accept the new matrix unless the calibration was carried out properly, and it asks you to verify that you want to use the new calibration if it is not as good as the previous calibration. There are three compass calibrations to choose from; one only corrects for hard iron while the other two correct for both hard and soft iron characteristics for materials rotating with the H-ADCP. Hard iron effects are related to residual magnetic fields and cause single cycle errors while soft iron effects are related to magnetic permeability that distorts the earth's magnetic field and causes double cycle errors.

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

- a. Start *BBTalk*. Send a Break to wake up the H-ADCP.
- b. At the > prompt, type AR and press the **Return** key. This will return the compass to the factory calibration matrix.
- c. At the > prompt, type AF and press return. When the calibration procedure starts, choose the calibration type "c".
- d. Choose option "a" to start the calibration procedure. When prompted, rotate the H-ADCP slowly 360 degrees (approximately 5 degrees per second).
- e. If the calibration procedure is successful, it records the new calibration matrix to nonvolatile memory. The H-ADCP will not change its matrix unless the calibration is properly carried out.
- f. If the calibration procedure is not successful, return your H-ADCP to the original factory calibration, by using the AR-command. Try using the AR-command if you have trouble calibrating your compass. In some

circumstances, a defective compass calibration matrix can prevent proper calibration.

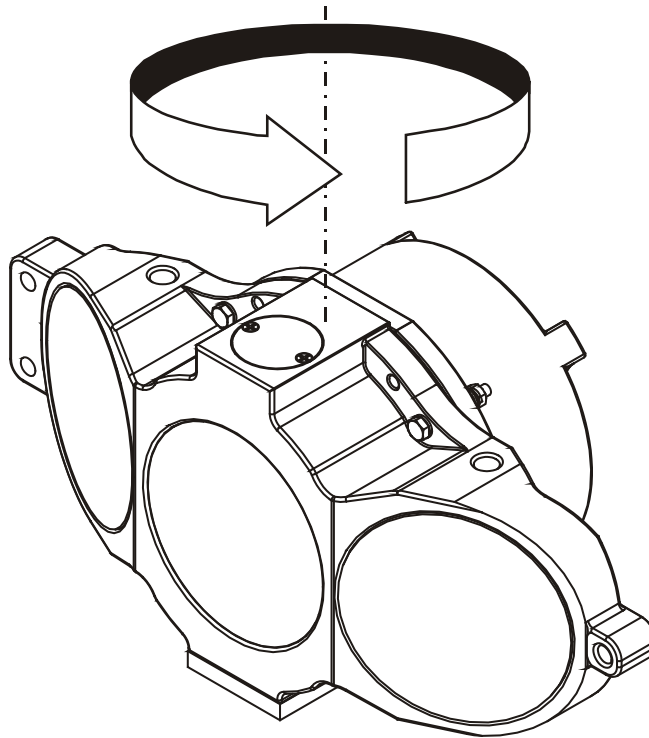


Figure 14. Compass Alignment

3.6 Fuse Replacement

There is one fuse located on the PIO Board (see Figure 30) that protects the H-ADCP from excessive incoming power. If this fuse continues to blow, check your input power before applying power again.

- a. Turn off the power.
- b. Remove the housing.
- c. The PIO board fuse is located next to the internal I/O connector. Use a small flat-blade screwdriver to open the fuse housing. Turn the end 180° (counter-clockwise) to open the fuse housing.
- d. Gently pull the fuse housing out. Turn the housing to remove the fuse.
- e. Check the fuse using an ohmmeter. Replace the fuse if necessary with the correct voltage and amperage fuse (see [Replaceable Parts](#)).
- f. Install the housing.
- g. Test the system.

3.7 Communications Setting

A switch on the PIO board (see Figure 15) changes the communication settings between RS-232 and RS-422. Your computer and the H-ADCP must both be set to the same communication setting. If the H-ADCP is set to communicate using RS-422, then it needs to be converted to RS-232 (at the PC end) before it can be connected to the PC's RS-232 serial port.

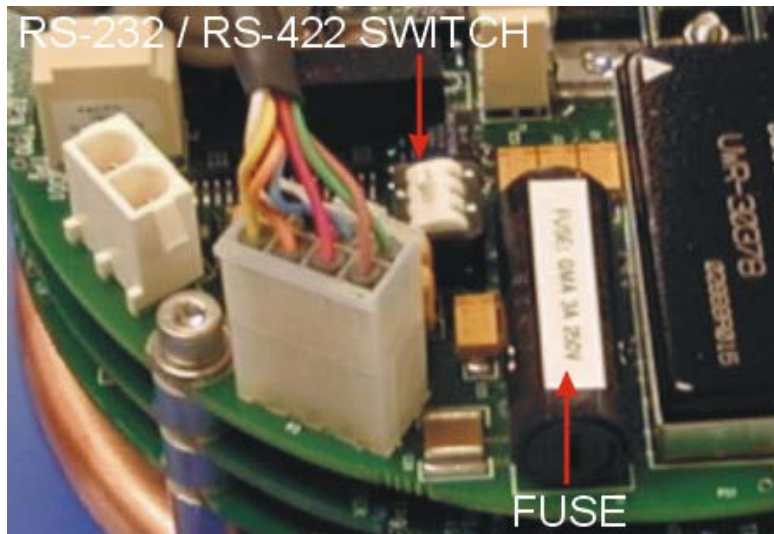


Figure 15. Communication Switch and Fuse

3.8 PC Card Recorder

The PC Card recorder is located on the Digital Signal Processor (DSP) board (see Figure 16). Data can be downloaded via the H-ADCP's serial port or the card can be removed and used in a Laptop.



NOTE. By default, the H-ADCP does not come with PCMCIA cards. Two PCMCIA memory cards slots are available, with the total memory capacity not to exceed 2GB.

To remove or install a PC card, do the following.

- a. Turn off power to the H-ADCP.
- b. Remove the housing (see [Housing Removal Procedures](#)).
- c. Remove the PC cards by pushing the button on the side of the PCMCIA card slot. The card should “pop” out of the connector. If you cannot reach the release button with your finger, use a plastic pen or non-conductive tool to depress the button. Do not try to force the card in or out of the connector. PC cards slide easily in or out when properly oriented.

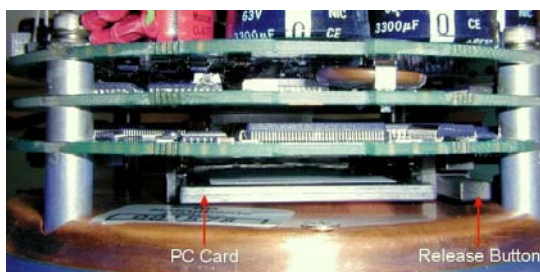


Figure 16. PC Card Recorder

- d. When you are finished recovering the data, install the PC card back into the DSP board.
- e. Install the housing (see [Housing Replacement](#)).



NOTE. TRDI uses a PCMCIA/ATA, 5-volt, type II memory cards. The H-ADCP can only read PCMCIA cards that are formatted with FAT12 or FAT16.

3.9 Desiccant Bags

Desiccant bags are used to dehumidify the housing interior. Desiccant is essential in deployments with plastic housings. The factory-supplied desiccant lasts a year at specified H-ADCP deployment depths and temperatures. Remember that desiccant rapidly absorbs moisture from normal room air.

The average dry weight of a new desiccant bag is 7.2 grams (5%). The weight increases to 8.4 to 9 grams for a “used” desiccant bag. Used desiccant bags may be dried at 250° for 14 hours. As a minimum, replace the desiccant bags (see [Replaceable Parts](#)) whenever you are preparing to deploy or store the H-ADCP for an extended time.



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



NOTE. Desiccant bags are shipped in an airtight aluminum bag to ensure maximum effectiveness. There is a moisture indicator inside the bag. If the moisture indicator is pink, do not use the desiccant bag until it has been dried. TRDI recommends replacing the desiccant bag just before the deployment.

- a. Remove the housing.
- b. Remove the new desiccant bags from the airtight aluminum bag.
- c. Remove the old desiccant bags and install two new ones. Place the desiccant bags (see [Replaceable Parts](#)) between the PIO board and the housing.
- d. Install the housing (see [Housing Replacement](#)).

3.10 Sealing the H-ADCP for a Deployment

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

- a. Check the H-ADCP electronics; there should be no loose screws or missing hardware.
- b. Install the PC card(s) if used
- c. Add two fresh desiccant bags inside the H-ADCP housing (see [Desiccant Bags](#)).
- d. Install the housing (see [Housing Replacement](#)).
- e. The H-ADCP is now ready for deployment unless you want to take steps to prevent biofouling (see [Prevention of Biofouling](#)).
- f. Use the Quick Start Guide to connect the H-ADCP system. See [Testing the H-ADCP](#) to test the H-ADCP before the deployment.

3.11 Protective Coating Inspection and Repair

TRDI uses paint on the housing for identification and corrosion protection. For more protection, the housing and the transducer assembly are first anodized. Do not damage the surface coatings when handling the H-ADCP. Inspect and repair the protective coating as follows. Read all instructions before doing the required actions.



NOTE. The procedures contained in this section apply to our standard aluminum systems. For systems made of other materials, contact TRDI.

- a. Inspect the housing, and transducer assemblies for corrosion, scratches, cracks, abrasions, paint blisters, exposed metal (silver-colored aluminum), exposed anodize (black or dark green), and exposed primer (yellow). Be critical in your judgment; the useful life of the H-ADCP depends on it.



CAUTION. The chemicals used in the following steps can be hazardous to your health. Read all material safety data sheets and manufacturer's instructions before handling these chemicals.

- b. If you are familiar with the repair of anodized coatings, proceed as follows; otherwise, send the H-ADCP to TRDI for repair.
 1. Clean and prepare the damaged area using a fine-grade abrasive cloth or a fine-grade abrasive silicon carbide wheel. Remove all corrosion from the bare aluminum.
 2. Clean the area with trichlorethane or alcohol. Do not touch the area after cleaning.
 3. Anodize per MIL-A-8625, Type 3, Class 1.

4. Seal with sodium dichromate only.
5. Paint repaired area as described in step c below.
- c. Proceed as follows to repair or touch up the protective paint.
 1. Remove all loose paint without damaging the anodizing. Clean and prepare the damaged area using a fine-grade abrasive cloth. Feather the edges of the paint near the damaged area. Try to have a smooth transition between the paint and the damaged area. Do not sand the anodized area. If you damage the anodizing, see step b above for repair.
 2. Clean the area with trichlorethane or alcohol. Do not touch the area after cleaning.
 3. Paint with one coat of epoxy primer (manufacturer's part number 4500; see note below).
 4. Paint with one coat of orange or black paint (manufacturer's part number 4512-B (orange), 4511-B (black); see note below).



NOTE. TRDI uses two-part epoxy type paint manufactured by Pro-line Paint Manufacturing company;

2426 Main St., San Diego, CA 92113

Phone: +1 (619) 231-2313

or

1168 Harbor, Long Beach, CA 98813

Phone: +1 (213) 432-7961

Manufacturer's part numbers:

4500-A, Pro-thane Paint, Catalyst, Part A

4511-B, Pro-thane Paint, Black, Part B

4512-B, Pro-thane Paint, Orange, Part B

3.12 Prevention of Biofouling

This section explains how to prevent the buildup of organic sea life (bio-fouling) on the transducer faces. Objects deployed within about 100 meters (≈ 328 feet) of the surface are subject to biofouling, especially in warm, shallow water.

Soft-bodied organisms usually cause no problems, but barnacles can cut through the urethane transducer face causing failure to the transducer and leakage into the H-ADCP (see Figure 17).

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

3.12.1 Controlling Biofouling

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

- Coat the entire H-ADCP with the recommended antifouling paint. Make sure that the paint is applied in an even coat over the transducer faces.
- Apply a thin coat (≈ 4 mm; ≈ 0.16 in.) of either a 50:50 mix of chili powder and petroleum jelly or chili powder and silicone grease to the transducer faces. The chili powder should be the hottest that can be found. Water flowing across the transducers will wash this mix away over time. The silicone mixture tends to last longer.



BEFORE



AFTER

Figure 17. Barnacle Damage



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

If using antifouling grease, remove the grease immediately after recovering the H-ADCP from its deployment. Remove the grease with soapy water. Be sure to wear protective gloves and a face shield.

CAUTION.

1. Do not arbitrarily use antifouling grease for deep-water applications. For shallow-water applications, barnacles are a threat to the transducer faces; using antifouling grease may be appropriate if you cannot clean the H-ADCP regularly (weekly). If using antifouling grease, remove it immediately after recovering the H-ADCP.
2. Antifouling grease is toxic. Read the product safety data sheet before using the grease. Wear gloves and a face shield when applying the grease. If the skin comes in contact with the grease, immediately wash the affected area with warm, soapy water.
3. All U.S. coastal states prohibit the use of tributyl-tins on boat hulls. The European Economic Commission has released a draft directive that would prohibit the use of many organo-tins after July 1989. We strongly recommend you obey your local laws.

3.12.2 Antifouling Paints

You can use almost any EPA approved anti-fouling paint on the housing or 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/



NOTE. Do not use antifouling paints that contain cuprous oxide on aluminum as it will cause galvanic corrosion.

3.12.3 Applying Antifouling Paints

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

- d. On painted surfaces, use Scotch Bright® or 220-grit sandpaper to remove gloss.
- e. Thoroughly clean the areas to be painted with soapy water and dry before applying the anti-fouling paint.
- f. Mask as necessary. Do not paint over mounting hardware, anodes, pressure sensors, etc.
- g. If applying a second coat, allow the first coat to dry. One coat usually lasts one season (3-4 months); two coats might last one year.

- h. You do have to be extra careful with the urethane faces to apply a smooth, thin coat of paint.
- i. Apply one or two coats of anti-fouling paint at 4 mil/coat.



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



(Photo courtesy of BMT SMS)

Figure 18. Antifouling Paint Applied on two H-ADCPs

3.13 Pressure Sensor

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

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

- a. Connect and apply power to the system as described in the [Quick Start Guide](#).
- b. Start *BBTalk* and wakeup the H-ADCP (press the **END** key).
- c. Type **AZ** and press the **Return** key.
- d. Exit *BBTalk*.

3.13.1 Pressure Sensor Maintenance

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



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

- a. Place the H-ADCP on its' side, pressure sensor facing upward. Use a soft pad to protect the H-ADCP.
- b. Use a straight-slot screwdriver to remove the copper screw.
- c. Gently clean out the hole in the copper screw with a needle. If the hole becomes enlarged or the screw is corroded, replace the screw. A replacement copper screw is included in the spare parts kit (part number 817-1067-00).
- d. Install the copper screw. Tighten the screw "finger tight" (0.226 N-m, 2 lbf-in). Do not over tighten the screw or you may strip the threads on the plastic cover disc. If this happens, return the H-ADCP to TRDI for repair.



CAUTION.

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

Do not touch or attempt to clean the surface of the pressure sensor. To do so may severely distort and ultimately ruin the sensor. The sensor diaphragm is very thin and easy to damage.



NOTE. If you are concerned about sediment depositing in the pressure port, it is possible to fill the pressure port with oil, but understand that **TRDI does NOT recommend this.**

Although it may be common practice to fill the pressure port with oil in pressure sensors pointing up or in sedimented waters, one must be careful about the following:

1. Use Dow Corning Q7-9120 Silicone fluid, 12.500 CST.
2. The entire pressure port must be properly filled. This includes filling the copper pressure port hole with oil. This is usually quite difficult and should you not do it properly, **air could be trapped in the pressure port and bias the pressure sensor.**
3. The sediment deposit will mix with the oil and will now have to be flushed as part of the maintenance of the pressure port instead of simply cleaning the pressure port hole. **Sediment-Oil mix has proven to be difficult to flush/clean from the pressure port.**

3.14 Storage and Shipping Maintenance

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

- Removing biofouling (see [Removal of Biofouling](#)).
- Inspecting the transducer head (see [Transducer Head Inspection](#)).
- Preparing the H-ADCP for final storage or shipping (see [Final Storage or Shipping Preparation](#)).

3.14.1 Removal of Biofouling

Before storing or shipping the H-ADCP, remove all foreign matter and biofouling. Remove soft-bodied marine growth or foreign matter with soapy water. Waterless hand cleaners remove most petroleum-based fouling. Rinse with fresh water to remove soap residue. Dry the transducer faces with low-pressure compressed air or soft lint-free towels.



CAUTION. The soft, thin urethane coating on the transducer faces is easily damaged. Do not use power scrubbers, abrasive cleansers, scouring pads, high-pressure marine cleaning systems, or brushes stiffer than hand cleaning brushes on the transducer faces.



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

If there is heavy fouling or marine growth, the transducer faces may need a thorough cleaning to restore acoustic performance. Barnacles do not usually affect H-ADCP operation. We do however recommend removal of the barnacles to prevent water leakage through the transducer face. Lime dissolving liquids such as Lime-Away® break down the shell-like parts. Scrubbing with a medium stiffness brush usually removes the soft-bodied parts. Do NOT use a brush stiffer than a hand cleaning brush. Scrubbing, alternated with soaking in Lime-Away®, effectively removes large barnacles. After using Lime-Away®, rinse the H-ADCP with fresh water to remove all residues. If barnacles have entered more than 1.0 to 1.5 mm (0.06 in.) into the transducer face urethane, you should send the H-ADCP to TRDI for repair (see Figure 17). If you do not think you can remove barnacles without damaging the transducer faces, contact TRDI.

3.14.2 Transducer Head Inspection

The urethane coating on the transducer faces is important to H-ADCP watertight integrity. Mishandling, chemicals, abrasive cleaners, and excessive depth pressures can damage the transducer ceramics or urethane coating. Inspect the transducer faces for dents, chipping, peeling, urethane shrinkage, hairline cracks, and damage that may affect watertight integrity or transducer operation. Repair of the transducer faces should only be done by TRDI.



CAUTION. Never set the transducer on a rough surface; always use foam padding to protect the transducers.

3.14.3 Final Storage or Shipping Preparation

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



CAUTION. If you are shipping a H-ADCP to TRDI for repair or upgrade, remove all customer-applied coatings or provide certification that the coating is nontoxic. This certification must include the name of a contact person who is knowledgeable about the coating, the name, and manufacturer of the coating, and the appropriate telephone numbers. If you return the equipment without meeting these conditions, we have instructed our employees not to handle the equipment and to leave it in the original shipping container pending certification. If you cannot provide certification, we will return the equipment to you or to a customer-specified cleaning facility. All costs associated with customer-applied coatings will be at the customer's expense.

When shipping the H-ADCP through a Customs facility, be sure to place the unit/s so identifying labels are not covered and can be seen easily by the Customs Inspector. Failure to do so could delay transit time.



NOTE. TRDI strongly recommends using the original shipping crate whenever transporting the H-ADCP.

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

For repackaging with commercially available materials, use the following procedure:

- a. Use a strong shipping container made out of wood or plastic.
- b. Install a layer of shock-absorbing static-shielding material, 70-mm to 100-mm thick, around all sides of the instrument to firmly cushion and prevent movement inside the container.

- c. Seal the shipping container securely.
- d. Mark the container FRAGILE to ensure careful handling.
- e. In any correspondence, refer to the H-ADCP by model and serial number.



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

3.15 Replaceable Parts

Table 4: 300/600 kHz H-ADCP Replaceable Parts

Item #	Part #	Description
1.	2-260	O-Ring, Face Seal, Duro 70 EPDM
2.	717-3008-00	Jumper, GND, Main Electronics
3.	817-1067-00	Screw, Pressure Sensor, H-ADCP
4.	817-3003-00	Washer, Felt H-ADCP Electronics
5.	DC-111	Lubricant, Silicone1, 5.3oz Tube
6.	DES3	Desiccant, Sealed Bag
7.	GMA-3A	Fuse, 5mm X 20mm 3A 250V
8.	M6WASHSPLTI	Washer, 6mm Split Lock
9.	M6WASHSTDIT	Washer, Flat, 12.5mm OD
10.	M6X1.0NUTTI	Nut, Hex, 10mm
11.	M6X1.0X45HHTI	Screw, Hex Head,
12.	M8WASHSPLTI	Washer, Split Lock
13.	M8WASHSTDIT	Washer, Flat, 12.5mm OD
14.	M8X1.25NUTTI	Nut, Hex, 13mm
15.	M8X1.25X65HHTI	Screw, Hex Head,
16.	817-1067-00	Copper screw
17.	817-1086-00	Anode, transducer
18.	810-4006-00	Anode, housing

Table 5: 300 kHz NB H-ADCPs Replaceable Parts

Item #	Part #	Description
1.	2-260	O-Ring, Face Seal, Duro 70 EPDM
2.	2-258	O-Ring, Bore Seal, Duro 70 EPDM
3.	2-258, PARBAK	Backup O-Ring, 8-258 N300-90, PARBAK
4.	811-4007-00	Bushing, L
5.	717-3008-00	Jumper, GND, Main Electronics
6.	817-1067-00	Screw, Pressure Sensor, H-ADCP
7.	817-3003-00	Washer, Felt H-ADCP Electronics
8.	DC-111	Lubricant, Silicone1, 5.3oz Tube
9.	DES3	Desiccant, Sealed Bag
10.	GMA-3A	Fuse, 5mm X 20mm 3A 250V
11.	N/A	M6 Washer, 6mm Split Lock
12.	N/A	M6 Washer, Flat, 12.5mm OD
13.	N/A	M6 Washer, Flat, Nylon
14.	C28022	M6 Insulator
15.	M6X1.0	M6 Nut, Hex, 10mm
16.	M6X1.0X45316SST	M6 Bolt, Hex Head,
17.	N/A	M8 Washer, Split Lock
18.	N/A	M8 Washer, Flat,
19.	M8X1.25	M8 Nut, Hex,
20.	305D0010	M8 Insulating Washer
21.	M8X1.25X80316SST	M8 Bolt, Hex Head,
22.	817-1067-00	Copper screw
23.	817-1086-00	Anode, transducer
24.	810-4006-00	Anode, housing

4 Data Recovery

The H-ADCP is typically setup and deployed such that it records a single data file, is recovered, and that file is recovered from the recorder. The user then will erase the recorder card and setup the H-ADCP for the next deployment. In some cases it is desirable to remotely recover the data and then redeploy without erasing the recorder or pulling the H-ADCP out of the water. This results in multiple data files being recorded to the H-ADCP recorder card. This is not an issue for the recorder. The standard TRDI software will still recover all files from the recorder card.

The following document describes all of the options available for recovering the data from a H-ADCP recorder board.

4.1 Recover the Entire Recorder with the WinSC Program

The default recommendation by TRDI is to use our software program *WinSC* to test, setup, deploy, and recover data from your WH. This option handles all of the command control for you, and so makes it very easy to recover the data. This method will recover all of the data on the recorder and so in some cases (especially where multiple files exist), this may not be desirable.

4.2 Recover a Single File using BBTalk

The *BBTalk* program can recover a single file from the recorder. To initiate the process, start the *BBTalk* program, send a BREAK to wake up the WH, and send CR1. Then on the menu bar, click **File** and then the **Recover Recorder...** selection. This process will ask you to select your recording directory path. After selecting the path and clicking **OK**, *BBTalk* will then display the H-ADCP recorder's contents.

To recover a single file, click the filename in the H-ADCP recorder's contents, and then click **OK**. When the recorder data has been recovered, the *BBTalk* program will display "Recovery Complete".

4.3 Recover the Entire Recorder using BBTalk

Another option is to use the TRDI software program *BBTalk* to recover the entire recorder. The process is nearly identical to the process above for recovering a single file from the recorder with the *BBTalk* program. The *BBTalk* program has an automated data recovery function similar to the *WinSC* program. To initiate the process, start the *BBTalk* program, send a BREAK to wake up the WH, and send CR1. Then on the menu bar, click **File** and then the **Recover Recorder...** selection. This process will ask you to select your recording directory path. After selecting the path and clicking **OK**, *BBTalk* will then display the H-ADCP recorder's contents.

To recover the entire recorder, click the **Select All Files** checkbox, and then click **OK**. When the entire recorder has been recovered, the *BBTalk* program will display “Recovery Complete”.

4.4 Recover a Single File Using Direct Commands

Another option is to use direct commands to recover a single data file from the H-ADCP recorder. The following command sequence should be used. Note it is assumed the user has applied power to the H-ADCP and has setup the communications cable and baud rate properly with a host computer using *BBTalk*.

Step	Command/Action	Description
1	Send Break	This is a >100ms transition signal sent to the H-ADCP to wake it up. The response will be to receive the H-ADCP wake-up banner followed by a prompt “>”. Example: [BREAK Wakeup A] WorkHorse Broadband ADCP Version 16.30 RD Instruments (c) 1996-2008 All rights reserved. >
2	CR1	This places the H-ADCP in factory default mode. The H-ADCP will respond confirming that it has been reset to factory defaults, and outputting a prompt. Example: >cr1 [Parameters set to FACTORY defaults] >
3	RR	The H-ADCP will display the recorder’s contents.
4	RY##	The RY command will start the Y-Modem protocol routine. The ## selects the file number you wish to recover. Find your file in the H-ADCP recorder contents display. Ignoring the volume name, FORMAT, and DIR listings at the top of the directory, as well as data files containing 0 bytes, count down from the top (first non-zero) data file to your file. If you see that your file is the fifth file in the recorder, use RY05. Once you send the RY## command you will be prompted to select your recording directory path to save the recorder data. When you click OK, the download will begin. When your file is downloaded, the <i>BBTalk</i> program will display “Recovery Complete”.
5	Repeat step 4 to recover another data file, or exit	The Y-Modem when complete will stop. You can recover another file or turn off power to the H-ADCP (and exit <i>BBTalk</i> if you are using this program).

4.5 Recover the Entire Recorder Using Direct Commands

Another option is to use direct commands to recover the entire recorder data from the H-ADCP recorder. The following command sequence should be used. Note it is assumed the user has applied power to the H-ADCP and has setup the communications cable and baud rate properly with a host computer using *BBTalk*.

Step	Command/Action	Description
1	Send Break	This is a >100ms transition signal sent to the H-ADCP to wake it up. The response will be to receive the H-ADCP wake-up banner followed by a prompt ">". Example: [BREAK Wakeup A] WorkHorse Broadband ADCP Version 16.30 RD Instruments (c) 1996-2008 All rights reserved. >
2	CR1	This places the H-ADCP in factory default mode. The H-ADCP will respond confirming that it has been reset to factory defaults, and outputting a prompt. Example: >cr1 [Parameters set to FACTORY defaults] >
3	RY	This will start the Y-Modem protocol routine. You will be prompted to select your recording directory path to save the recorder data. When you click OK, the download will begin. When the entire recorder is downloaded, the BBTalk program will display "Recovery Complete".

5 Testing the H-ADCP

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

- a. Start the *BBTalk* program (for help on using *BBTalk*, see the RDI Tools User's Guide).
- b. On the **Connect To** screen, select **WorkHorse**.
- c. Select the serial port where the H-ADCP cable is connected to.
- d. Click **Next**.
- e. Enter the **Baud Rate**, **Parity**, **Stop Bits**, and **Flow Control**. If you are unsure of the settings, leave them at the default settings.
- f. Click **Next**, than **Finish**.
- g. On the **File** menu, click **Break** (you can also press the **End** key to send a break or use the Toolbar and press the blue **B** button).
- h. You should see the wakeup message appear on the log file window.

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

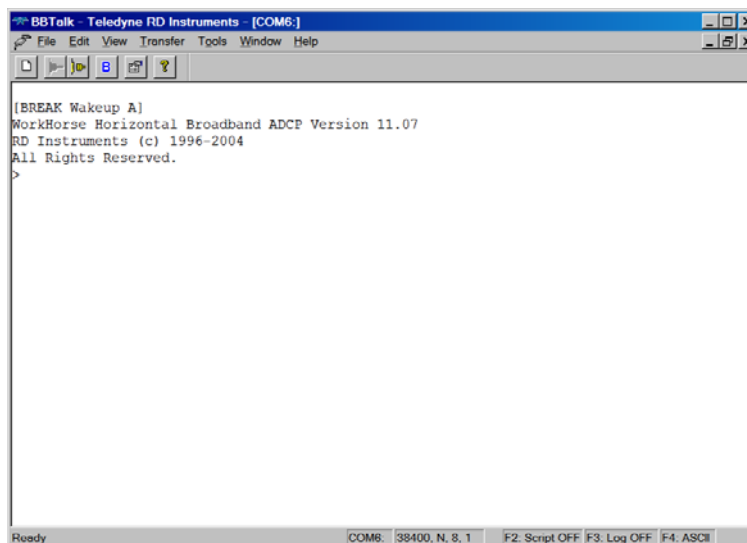


Figure 19. Testing the H-ADCP

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

- j. At the ">" prompt in the communication window, enter the direct command **CK** then press the Enter key. This will save the factory default setting as the default power up condition.
- k. At the ">" prompt in the communication window, enter the direct command **PS0** then press the Enter key. This will display the H-ADCP system configuration data.

```
>cr1
[Parameters set to FACTORY defaults]
>ck
[Parameters saved as USER defaults]
>ps0
Instrument S/N: 3192
Frequency: 307200 HZ
Configuration: 3 BEAM, HORIZONTAL
Beam Angle: 25 DEGREES
Beam Pattern: CONVEX
Orientation: UP
Sensor(s): HEADING TILT 1 TILT 2 DEPTH TEMPERATURE PRESSURE
Pressure Sens Coefficients: (c3,c2,c1,offset) 0.00,0.00,0.01,-1.15

Temp Sens Offset: -0.22 degrees C

CPU Firmware: 11.07 [0]
Boot Code Ver: Required: 1.13 Actual: 1.13
DEMOM #1 Ver: ad48, Type: 1f
DEMOM #2 Ver: ad48, Type: 1f
PWRTIMG Ver: 85d3, Type: 6

Board Serial Number Data:
D1 00 00 00 E6 FD 28 09 PIO727-3013-04X
B4 00 00 00 E7 09 74 09 REC727-1015-04X
34 00 00 00 E6 F8 29 09 CPU727-2000-00H
A9 00 00 02 C9 37 69 09 DSP727-2001-04F
>
```

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

```
>pa

PRE-DEPLOYMENT TESTS

CPU TESTS:
RTC.....PASS
RAM.....PASS
ROM.....PASS
RECORDER TESTS:
PC Card #0.....NOT DETECTED
Card Detect.....PASS
Communication.....PASS
DOS Structure.....PASS
Sector Test (short).....PASS
PC Card #1.....NOT DETECTED
DSP TESTS:
Timing RAM.....PASS
Demod RAM.....PASS
Demod REG.....PASS
FIFOs.....PASS
SYSTEM TESTS:
XILINX Interrupts... IRQ3 IRQ3 IRQ3 ...PASS
Receive Loop-Back.....PASS
Wide Bandwidth.....PASS
Narrow Bandwidth.....PASS
RSSI Filter.....PASS
Transmit.....PASS
SENSOR TESTS:
H/W Operation.....PASS
>
```

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

>Pt3

Correlation Magnitude: Narrow Bandwidth

Lag	Bm1	Bm2	Bm3
0	255	255	255
1	144	144	146
2	70	71	73
3	37	33	35
4	24	18	18
5	13	12	8
6	6	5	2
7	3	2	1

High Gain RSSI:	71	67	74
Low Gain RSSI:	16	16	18

SIN Duty Cycle:	49	52	49
COS Duty Cycle:	48	50	48

Receive Test Results = \$000 ... PASS
>

6 Troubleshooting

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



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

Table 6: List of Least Replaceable Assemblies

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

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

6.1 Basic Steps in Troubleshooting

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

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

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

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

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

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

6.2 Troubleshooting the H-ADCP

Although the H-ADCP is designed for maximum reliability, it is possible for a fault to occur. This section explains how to troubleshoot and fault isolate problems to the Least Replaceable Assembly level (see Table 6). Before troubleshooting, review the procedures, figures, and tables in this section. Also, read the [Functional Description of H-ADCP Operation](#) to understand how the H-ADCP processes data.



CAUTION. Under all circumstances, follow the safety rules listed in the [Troubleshooting Safety](#).

6.2.1 Troubleshooting Safety

Follow all safety rules while troubleshooting.



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



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



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



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



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



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



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



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



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

6.2.2 Troubleshooting a Communication Failure

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

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



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



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



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

Incorrect Wakeup Message

When you send a break and the wakeup message is not readable (garbled) may indicate a communications mismatch or lost boot code.

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

No Wakeup Message

When you send a Break and do not see the wakeup message, you need to isolate the problem to a computer fault, power, cable failure, or an H-ADCP problem. Check the following items:

- a. Connect the H-ADCP to a computer as shown in Figure 3. Check that all cable connections are tight.
- b. Is the H-ADCP AC power adapter working? Is the input voltage to the AC power adapter between 100 to 240 VAC? Is the output level 48 VDC?
- c. If the H-ADCP is running from a battery, check that the battery voltage is above 30 VDC. H-ADCPs will work at 20 VDC with at least 400 milli amps; however, both lithium and alkaline battery packs with voltages below 30 VDC are at or near their end of life, and are approaching uselessness.
- d. Is the computer hooked up properly? Does it have power?
- e. Make sure that your computer and the *BBTalk* programs are set up to use the communication port the serial cable is connected to on the computer.

6.2.3 Check the Power

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

Check the power going into the H-ADCP by measuring the voltage on the end of the cable that connects to the H-ADCP at Pins 3 and 7 (GND) (see Figure 28). The voltage should be +48 VDC (using the standard AC adapter). If not, check the voltage at the other end of the cable and the AC adapter.

6.2.4 Check the I/O Cable

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

- a. Disconnect both ends of the cable and measure the continuity using a DMM (see Figure 24 for the wiring diagram). Correct any problems found.
- b. Reconnect the I/O cable to host computer.
- c. Load *BBTalk* on your computer. Select the proper communications port (see the TRDI Tools User's Guide for help on using *BBTalk*).
- d. For RS-232 communications, short pins 1 and 2 together on the female 7-pin connector that was plugged into the H-ADCP (see Figure 25). If you are using RS-422, connect a jumper between pin 2 to pin 6 and another jumper between pins 1 to pin 5 of the underwater connector at the H-ADCP end of the cable.
- e. Type any characters on the keyboard. The keys you type should be echoed on the screen. If you see characters, but not correctly (garbage), the cable may be too long for the baud rate. Try a lower baud rate. If this works disconnect the jumper on pins 1 and 2 and then push any keys on the keyboard. You should NOT see anything you type.
- f. If the keys are echoed correctly on the screen, the computer and the communication cable are good. Re-connect the I/O cable to the H-ADCP. The above loop-back test does not show if transmit and receive pairs are interchanged. Thus, it is important that you check the wiring diagrams provided in [H-ADCP Cables](#).



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

6.2.5 H-ADCP Checks

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

Cold Start the H-ADCP

- a. Remove the housing to gain access to the PC boards.
- b. Remove *all* power to the H-ADCP.



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

- c. Short TP10 to TP11 on the PIO board for 10 seconds.
- d. Remove the jumper.
- e. Connect the computer and connect power to the H-ADCP. Send a break to the H-ADCP. This should start the H-ADCP in the “cold start” mode.

Fuse

Check the fuse on the PIO board is not blown (see [Fuse Replacement](#)).



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

Boot Code Error

If the H-ADCP gives a steady “beep” when power is applied, the “>” prompt appears on the screen, and an “X” appears when additional breaks are sent, this may indicate that the boot code has been lost. This can happen if you abort while downloading new firmware. Try downloading the firmware again (see [Firmware Updates](#)).

6.3 Troubleshooting a Built-In Test Failure

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

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

6.3.1 When to use the Spare Boards Kit

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

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

CPU Tests:

- RTC
- RAM
- ROM

DSP Tests:

- Timing RAM
- Demod RAM
- Demod REG
- FIFOs

System Tests:

- XILINK Interrupts
- Receive Loop Back Test
- Your H-ADCP fails any of the following PA tests provided the items indicated by { } have been checked:

Recorder Tests:

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

System Tests:

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

Sensor Tests:

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

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

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

System Tests:

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

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

RSSI Filter

Transmit

Table 7: Pre-deployment Test (PA) Possible Cause of Failures

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

6.3.2 Installation of the Spare Board Kit

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



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

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

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

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

6.3.3 Remove the Original Set of Boards

- a. Remove the housing assembly.
- b. With your earth-ground static protection strap on, use a 3mm Allen wrench, to remove the four bolts that secure the three original H-ADCP boards to the Transducer assembly.
- c. Note the orientation of the transmit cable connector as it is plugged into the PIO board and to the Receiver board (see Figure 20).

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

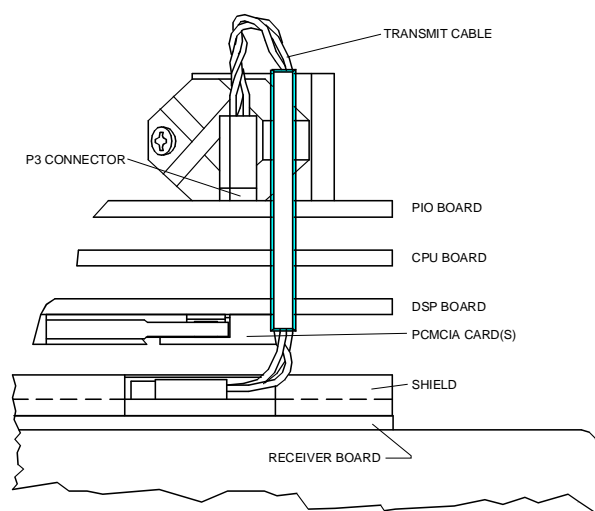


Figure 20. Transmit Cable

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

These top three boards are connected to each other via connectors and will remain as one piece (see Figure 21). The DSP board connects to the Receiver board through a 26-pin header. The 26-pin header is a series of male pins. The 26-pin header may or may not stay connected to the DSP board when you remove the top three boards. If you see that there are male pins sticking out of the DSP board when you finish removing the board set then the header has remained attached to the DSP board. If this happens remove it and place it into the Receiver board. To remove it, gently rock it back and forth while pulling it away from the DSP board. Once removed, align it with the connector on the Receiver board and press it into place.

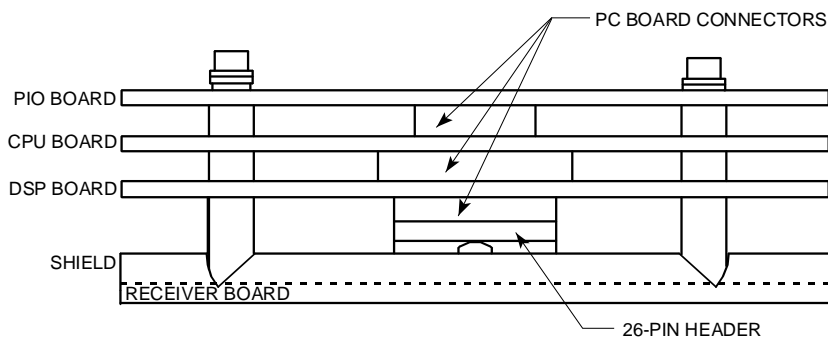


Figure 21. PC Board Connectors

- e. Remove all PCMCIA card(s) from the original set of boards. These PCMCIA cards will be used again once you install your Spare Boards Set. The Spare Board set does NOT contain a PCMCIA card(s). The PCMCIA card(s) are located on the bottom of the DSP board. To re-

move the PCMCIA card(s) press the button(s) on the side of the PCMCIA card slot. As you press this button the PCMCIA card will slide out. You will have to pull the card(s) out the rest of the way once the button is depressed all the way in.

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

6.3.4 Installing the Spare Board Kit

- a. With your earth-ground static protection strap on, remove the Spare Board Kit from the anti-static bag.
- b. Using a 3 mm Allen wrench and a 7 mm wrench remove the nuts from the bolts that secure the Spare Boards together. You will be using these bolts to secure the spare set in your system. DO NOT change the position of any of the bolts. The bolt containing the felt washers and ground jumper must remain in the same position (see Figure 22).

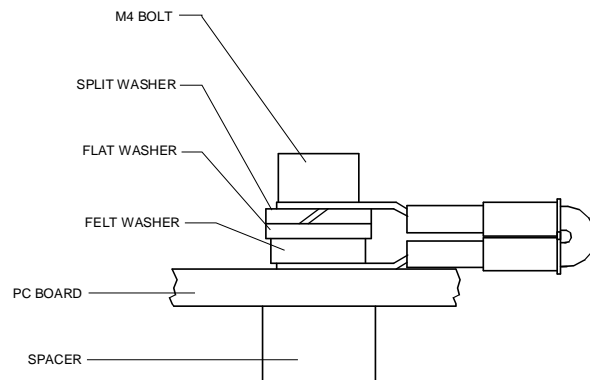


Figure 22. Ground Jumper

- c. Place the nuts (just removed) on the four bolts of your original set of boards and place them into the anti-static bag. You will use the new set of bolts included in the Spare Board kit to secure them to the Transducer assembly.
- d. Install all PCMCIA cards removed in [Remove the Original Set of Boards step e](#) into the PCMCIA card slots. The PCMCIA card is keyed and will only connect when it has been aligned correctly and slid all the way in. The PCMCIA card is installed with the label side pointing away from the DSP board.
- e. Connect the Spare Board set to the Receiver board. Align the Spare Board set to the 26-pin header connected to the Receiver board. As you connect the Spare Board set, connect the transmit cable you removed in [Remove the Original Set of Boards step c](#). Be sure to connect the cable in the same orientation as was installed on the original board set.

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

```
>
[BREAK Wakeup B]
WorkHorse Horizontal Broadband H-ADCP Version 11.07
RD Instruments (c) 1996-2004
All Rights Reserved.
>PT4
```

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

>
When the cable is connected, you should see the example shown below.

```
>PT4
IXMT   =      1.2 Amps rms  [Data=6dh]
VXMT   =    103.0 Volts rms [Data=aeh]
Z      =      82.5 Ohms
Transmit Test Results = $0 ... PASS
>
```

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

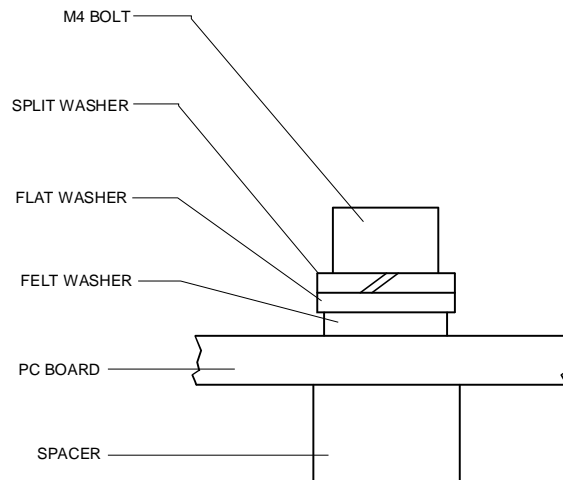


Figure 23. Mounting Hardware

6.3.5 Installing the Beam Cosine Matrix

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

- a. Connect your H-ADCP as you would normally and apply power.
- b. Start *BBTalk* and confirm that the H-ADCP is communicating normally and which communication port you are using (COM 1 or COM 2).
- c. Place the Beam Cosine Matrix Disk into your computer's disk drive.

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

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

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

6.3.6 Testing the System

- a. Install the housing.
- b. Connect the cable and power as you normally do and test as H-ADCP as shown in [Testing the H-ADCP](#). All PA tests should pass when run in water and the PC tests should pass out of water.
- c. **Perform a field calibration of your compass.** Use the [Compass Calibration](#) for instructions on running the AF command. Remember that there will be up to 1.5 degrees of offset error in the compass measurement. This error is not removed by the field calibration.

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

6.4 Troubleshooting a Beam Failure

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

```
>PC1

BEAM CONTINUITY TEST

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

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

Collecting Statistical Data...
 31 32 34

Rub Beam 1 = FAIL
Rub Beam 2 = FAIL
Rub Beam 3 = FAIL

>
```

6.5 Troubleshooting a Sensor Failure

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

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

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

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



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

6.5.1 Fault Log

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

```
>
[BREAK Wakeup A]
WorkHorse Horizontal Broadband H-ADCP Version 11.07
RD Instruments (c) 1996-2004
All Rights Reserved.
>cr1
[Parameters set to FACTORY defaults]
>fc .....
  Fault Log Cleared.

>pa
|          (PA test results not shown)
|
|
>fd
Total Unique Faults   =      0
Overflow Count        =      0
Time of first fault:   0/00/00,00:00:00.00
Time of last fault:    0/00/00,00:00:00.00

Fault Log:
The fault log is empty.

>
```

6.6 Technical Support

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

Teledyne RD Instruments

14020 Stowe Drive
Poway, California 92064

Phone +1 (858) 842-2600

FAX +1 (858) 842-2822

Sales – rdisales@teledyne.com

Field Service – rdifs@teledyne.com

Teledyne RD Instruments Europe

2A Les Nertieres
5 Avenue Hector Pintus
06610 La Gaude, France

Phone +33(0) 492-110-930

FAX +33(0) 492-110-931

Sales – rdie@teledyne.com

Field Service – rdiefs@teledyne.com

Customer Service Administration – rdicsadmin@teledyne.com

Web: <http://www.rdinstruments.com>

24 Hour Emergency Support +1 (858) 842-2700

6.7 H-ADCP Cables

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



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

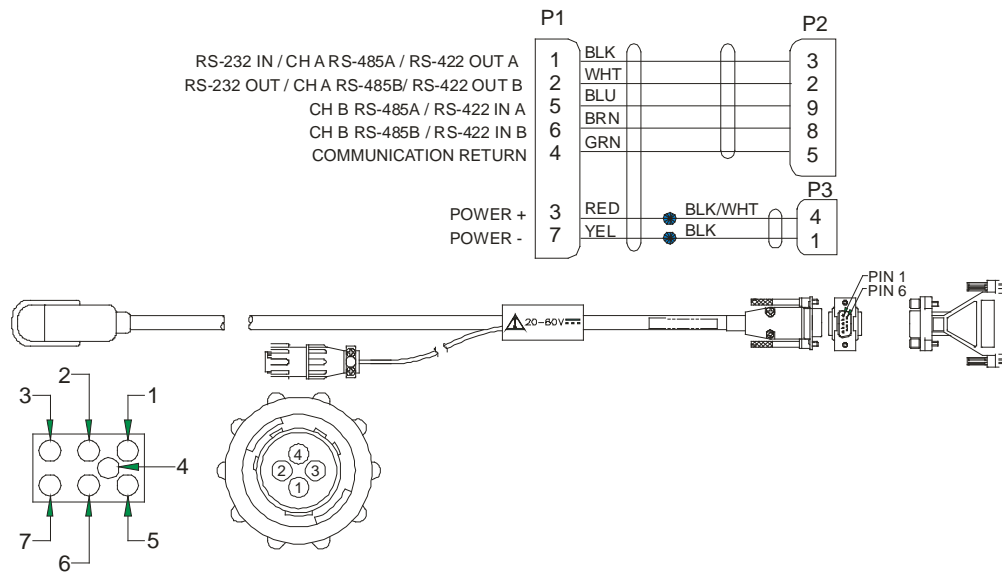


Figure 24. I/O Cable Wiring



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

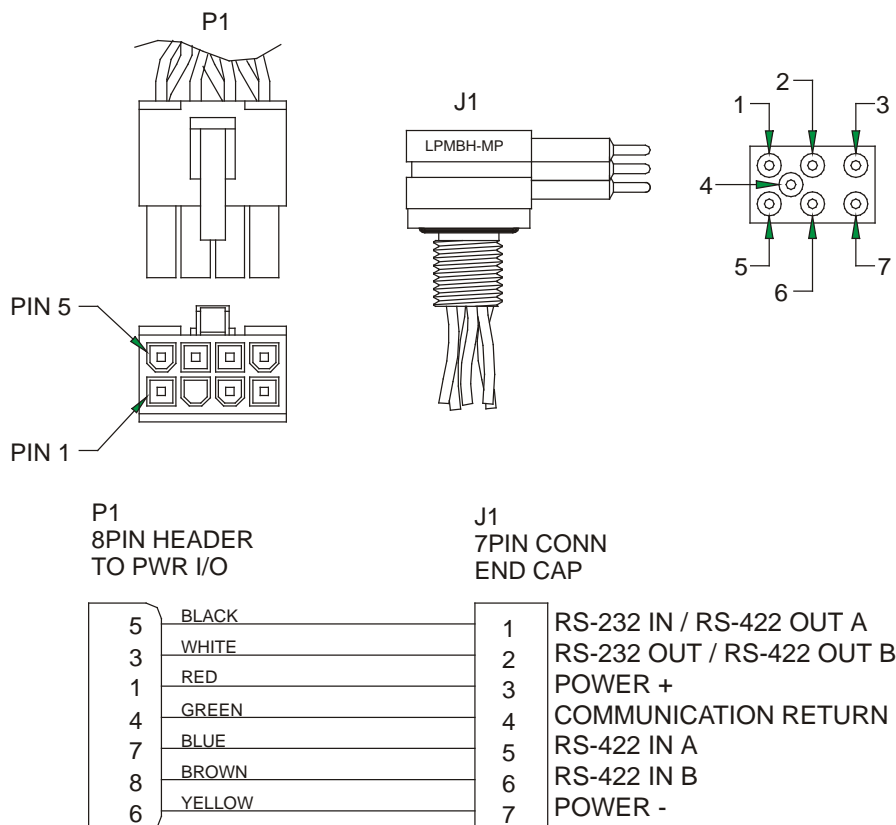


Figure 25. Internal I/O Cable (Housing to PIO Board) Wiring

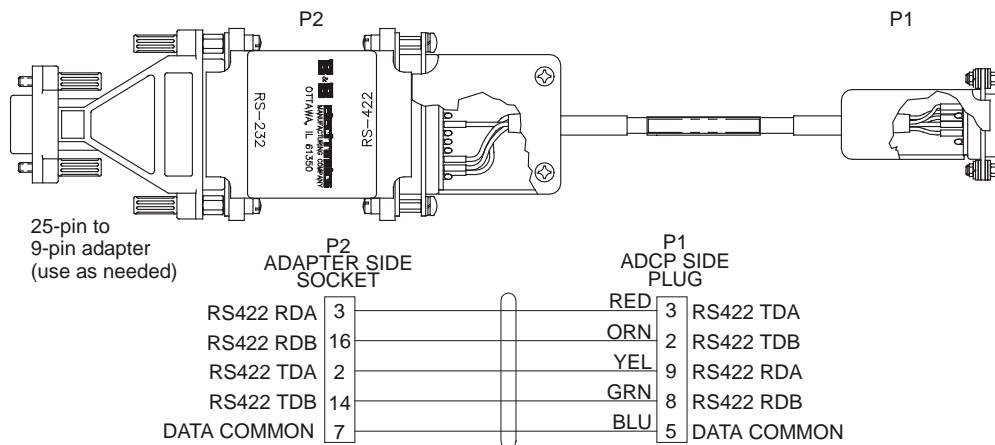


Figure 26. RS232-to-RS422 Converter Wiring (25-Pin to 9-Pin)



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

6.8 Functional Description of H-ADCP Operation

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

6.8.1 Operating Modes

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

Command Mode

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

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

Ping Mode

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

- If the H-ADCP receives a BREAK, it will go to the command prompt, but stays in the ping mode. If a valid command is received, the H-ADCP will switch to the command mode. If no valid command is received, a warning will be displayed after four minutes, in-

dicating that the system will self-deploy. After a total of five minutes with no input, the H-ADCP will resume pinging.

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

6.8.2 Overview of Normal H-ADCP Operation

Refer to Figure 27 through Figure 30. The following events occur during a typical data collection cycle.

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

Figure 27 shows a flow chart of the wake-up logic used by the H-ADCP. The H-ADCP determines what to do based on where the wake-up came from (a Break, CS-command, battery saver timer, or watchdog timer was detected).

- b. On the PIO Board, the POWER REGULATOR circuit sends a transmit command to the POWER AMPLIFIER circuit. This tells the H-ADCP to start acoustic transmissions (pinging) on all TRANSDUCERS.
- c. The TRANSDUCERS receive echoes from the backscatter. The RECEIVER board amplifies and translates the echoes into a base-band frequency.
- d. The CPU board processes the received echoes.

- e. After echo reception, the H-ADCP injects a self-test signal into the RECEIVER board and processes the signal as normal data for test purposes.
- f. The THERMISTOR measures water temperature at the transducer head and sends it to the CPU via the DSP Board.
- g. The PIO Board sends pitch and roll from the TILT SENSOR and H-ADCP heading from the COMPASS to the DSP Board. The DSP Board digitizes this information and sends it to the CPU for processing.
- h. The CPU repeats steps “b” through “g” for a user-defined number of pings. The CPU averages the data from each ping to produce an ensemble data set.
- i. At the end of the ensemble (sampling) interval, the CPU sends the collected data to the serial I/O connector or PCMCIA recorder.

6.8.3 Functional Description of Operation

The following paragraphs describe how the H-ADCP operates and interacts with its modules. Refer to Figure 27 through Figure 30 throughout this description.

Input Power

The H-ADCP requires a DC supply between 20 volts and 50 volts. Figure 28 shows the DC voltage power distribution path.

External DC Power Supply – With an external supply, power is applied to pins 3 (positive) and 7 (negative) on the external connector (see Figure 28). The power then goes through an electromagnetic interference (EMI) filter on the PIO Board. This filter reduces the chance that external noise sources associated with the external power source can disrupt H-ADCP operation.

Board Descriptions

PIO Board

- Receives the filtered/internal power.
- Uses a diode “OR” gate to determine which power source to use (external or internal). With both sources connected, the OR gate selects the “higher” voltage for H-ADCP use.
- Limits the in-rush of current to the H-ADCP and provides over- and negative-voltage protection. Either condition will blow a protective fuse. However, damage could occur to other circuits before the fuse blows. Please ensure you apply only voltages within the specified range (+20 to +50 VDC).

- Converts the operating power supply (filtered/isolated 20 to 50 VDC or 5 to 18 VDC) in a DC-to-DC converter to the +5 VDC (Vcc) used to power all other H-ADCP circuits.
- Uses the Power Amplifier circuit on the PIO board to generate the high-amplitude pulse AC signal that drives the sonar transducers. The Power Amplifier sends the drive signal to the Receiver Board.
- RS-232/RS-422 switch.

CPU Board

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

DSP Board

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

Receiver Board

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

Sensors

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

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

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

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

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

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

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

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

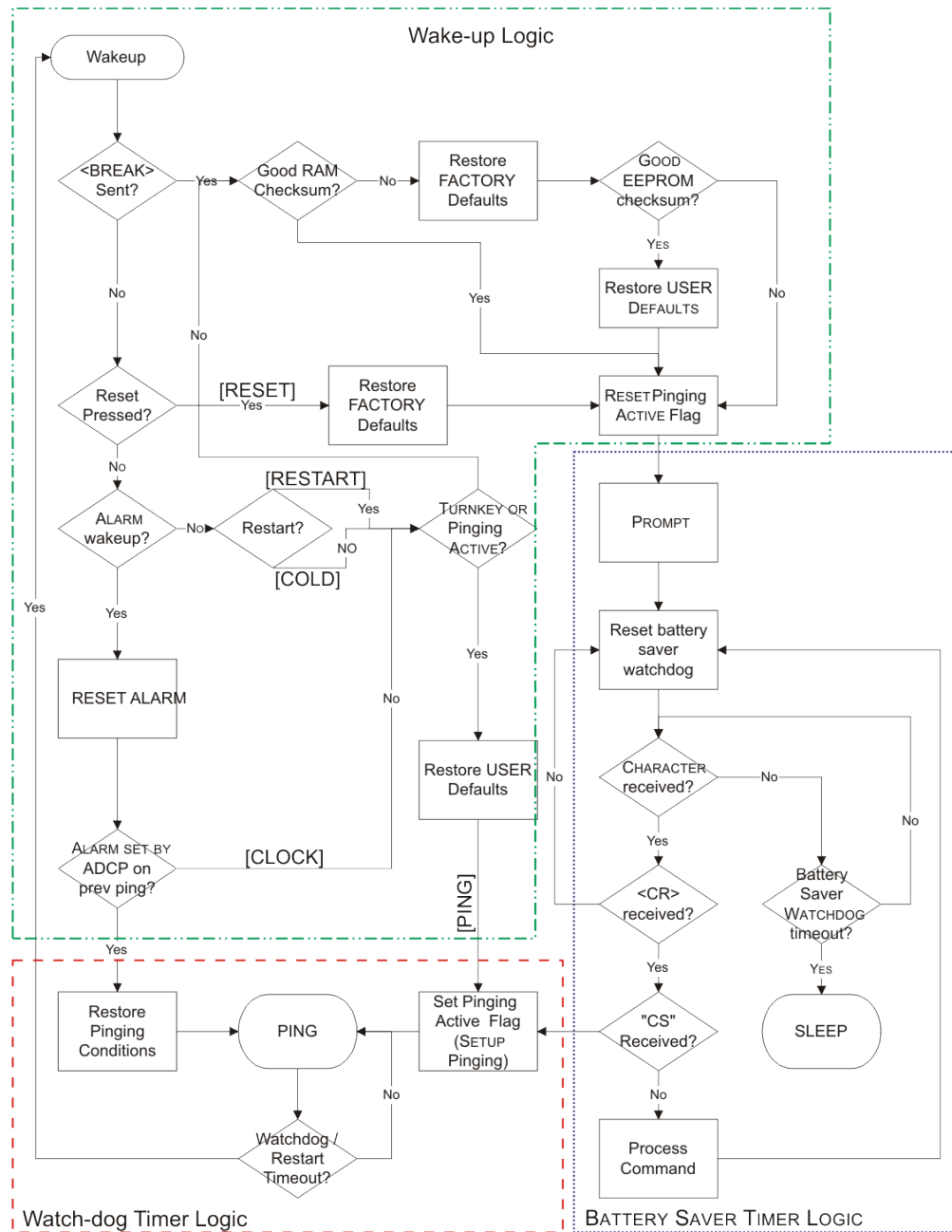


Figure 27. H-ADCP Wake-up and Timer Logic

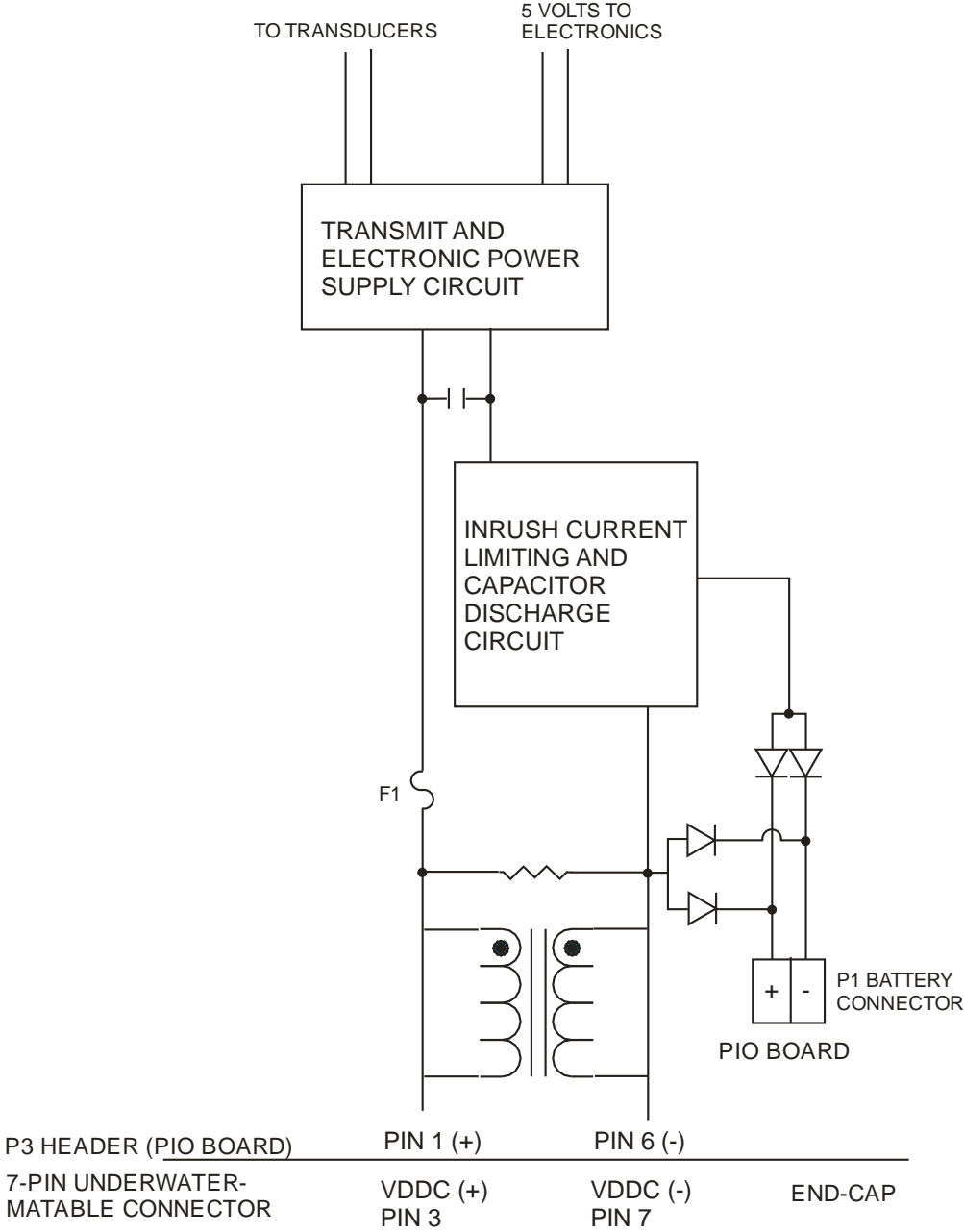


Figure 28. DC Power Path

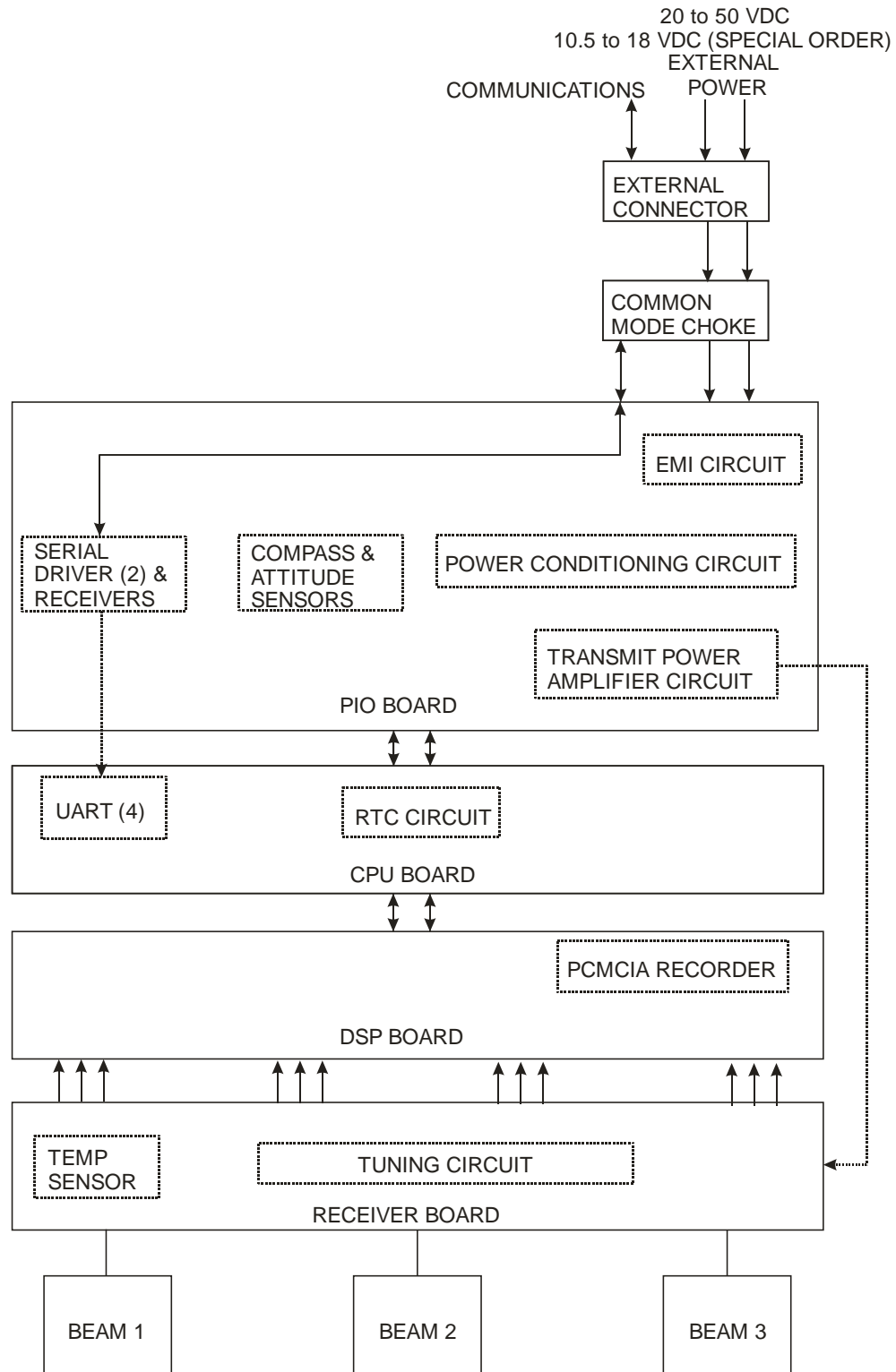


Figure 29. H-ADCP Block Diagram

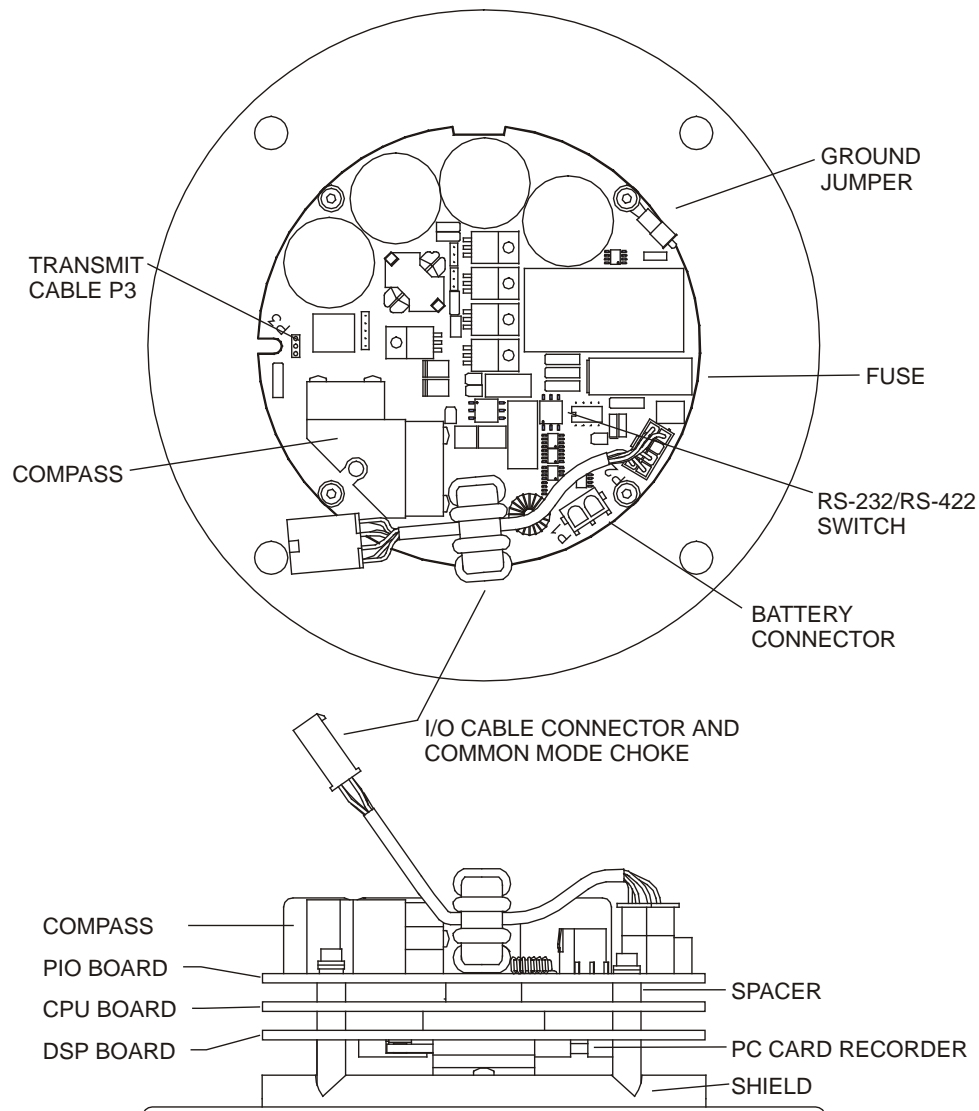


Figure 30. PC Board Locations

7 Returning H-ADCPs to TRDI for Service

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

7.1 Domestic Shipments

Step 1 - Get a Return Material Authorization

Send an e-mail to TRDI's Sales Administration (rdicsadmin@teledyne.com) or call Customer Service and request a Return Material Authorization (RMA)

number. 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 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
Notify Paxton, Shreve, and Hayes, San Diego Airport
Phone: +1 (619) 692-3113
Fax: +1 (619) 692-0539**

Step 4 - Urgent shipments

Send the following information by fax or telephone to TRDI.

Attention: Customer Service Administration

Fax: +1 (858) 842-2822

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

7.2 International Shipments

Step 1 - Get a Return Material Authorization

Send an e-mail to TRDI's Sales Administration (rdiefs@teledyne.com) or call Customer Service and request a Return Material Authorization (RMA) number. 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 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 4 - Send the Following Information by Fax or Telephone to TRDI

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

- Detailed descriptions of what you are shipping (number of packages, sizes, weights, and contents).
- The name of the freight carrier
- Master Air bill number
- Carrier route and flight numbers for all flights the package will take

8 Specifications

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



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

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

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

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

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

- a. All these specifications assume minimal H-ADCP motion - pitch, roll, heave, rotation, and translation.
- b. Except where noted, this specification table applies to typical setups and conditions. Typical setups use the default input values for each parameter (exceptions include Pings Per Ensemble and Number of Cells). Typical conditions assume uniform seawater velocities at a given depth, moderate shear, moderate H-ADCP motion, and typical echo intensity levels.
- c. The total measurement error of the H-ADCP is the sum of:
 - Long-term instrument error (as limited by instrument accuracy).
 - The remaining statistical uncertainty after averaging.
 - Errors introduced by measurement of H-ADCP heading and motion.
- d. Because individual pings are independent, the statistical uncertainty of the measurement can be reduced according to the equation:

Statistical Uncertainty for One Ping

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

Table 8: Water Profiling

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

NOTES

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

Table 9: Long Range Mode

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

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

Table 10: Profile Parameters**Velocity accuracy**

1200 and 600kHz	$\pm 0.25\%$ of the water velocity relative to the H-ADCP $\pm 2.5\text{mm/s}$
300kHz	$\pm 0.5\%$ of the water velocity relative to the H-ADCP $\pm 5\text{ mm/s}$

Velocity resolution 1 mm/s

Velocity range $\pm 5\text{m/s}$ (default), $\pm 20\text{m/s}$ (maximum)

Number of cells 1 to 128

Ping rate 2 Hz (typical)

Table 11: Echo Intensity Profile

Vertical resolution	Depth cell size
Dynamic range	80 dB
Precision	$\pm 1.5\text{dB}$ (relative measure)

Table 12: Standard Sensors**Temperature (mounted on transducer)**

Range: -5° to 45° C

Precision: $\pm 0.4^\circ\text{ C}$

Resolution: 0.01°

Tilt

Range: $\pm 15^\circ$

Accuracy: $\pm 0.5^\circ$

Precision: $\pm 0.5^\circ$

Resolution: 0.01°

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

Accuracy: $\pm 2^\circ$ ¹

Precision: ± 0.50 ¹

Resolution: 0.01°

Maximum tilt: $\pm 15^\circ$

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

Table 13: Transducer and Hardware

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

Table 14: Environmental

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

Table 15: Power

DC input	20 to 50 VDC external power supply
Transmit	22W @ 48V (1200kHz), 60W @ 48V (600kHz), 190W @ 48V (300kHz)
Special Order	
DC Input	10.5 to 18 VDC
Transmit	35W @ 13V (600kHz), 25W @ 13V (1200kHz)

8.1 Outline Installation Drawings

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

Table 16: Outline Installation Drawings

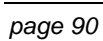
Description	Drawing #
600 kHz H-ADCP	967-1004
300 kHz H-ADCP	967-1015
300 kHz Narrow Beam Width H-ADCP (early builds)	967-6043
300 kHz Narrow Beam Width H-ADCP (one piece housing)	967-6095
300 kHz Narrow Beam Width H-ADCP (two piece housing)	967-6096

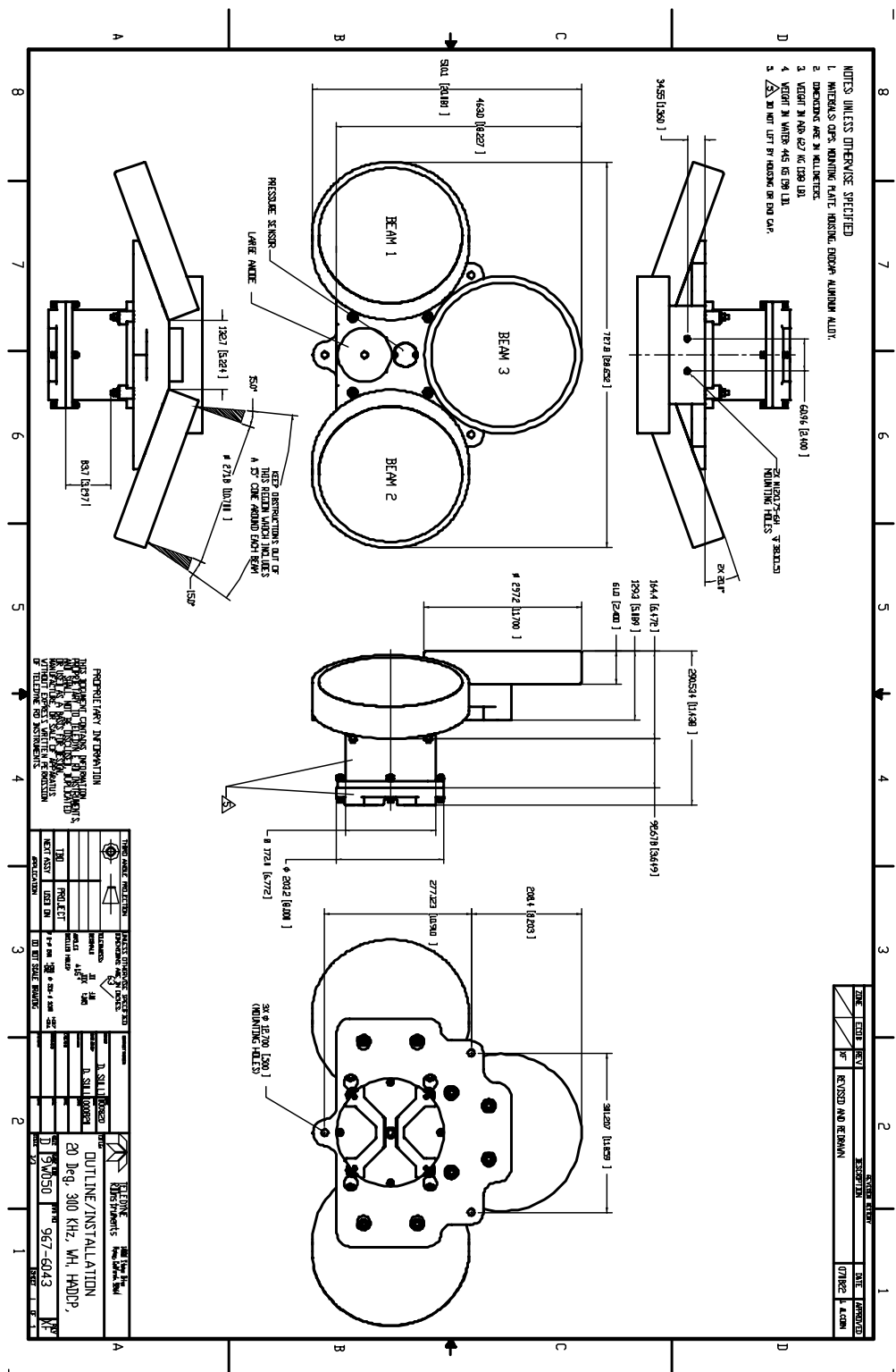


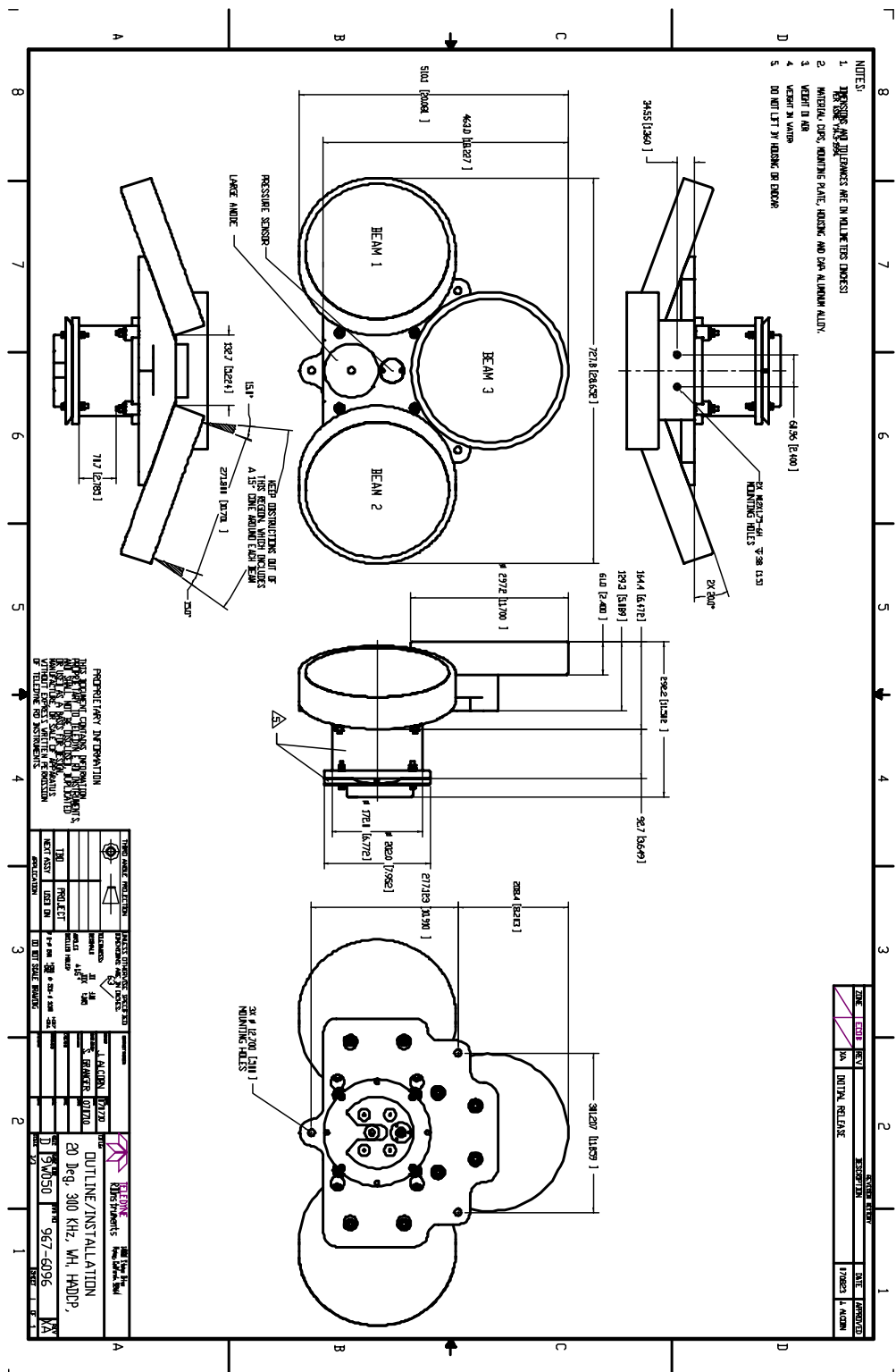
NOTE. If you are having difficulty reading the text on the Outline Installation drawings, the Acrobat Reader allows you to zoom in and rotate the graphics.



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







9 Introduction to H-ADCP Commands

This section defines the commands used by the H-ADCPs. These commands (Table 18) let you set up and control the H-ADCP without using an external software program such as our *WinH-ADCP* or *WavesMon*, programs. However, we recommend you use our software to control the H-ADCP because entering commands directly from a terminal can be difficult. *Make sure you read and understand [Using Direct Commands to Deploy your H-ADCP](#) before deploying your H-ADCP.* Most H-ADCP settings use factory-set values (Table 19). 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.

Using *WinH-ADCP* / *WavesMon* for real-time deployments to develop the command file will ensure that the H-ADCP is set up correctly. The commands shown in Table 18 directly affect the range of the H-ADCP, the standard deviation (accuracy) of the data, and battery usage.



NOTE. These commands apply to H-ADCP firmware version 11.08.

When new firmware versions are released, some commands may be modified, added, or removed. Read the README file on the upgrade disk. When an addition or correction to this manual is needed, an Interim Change Notice (ICN) will be posted to our web site. Please check our TRDI's web site often at www.rdinstrument.com.

9.1 Data Communication and Command Format

You can enter commands with an IBM-compatible computer running TRDI's *BBTalk*. The H-ADCP communicates with the computer through an RS-232 (or RS-422) serial interface. We initially set the H-ADCP at the factory to communicate at 9600 baud, no parity, and one stop bit.

Immediately after you apply power to the H-ADCP, it enters the STANDBY mode. Send a BREAK signal using *BBTalk* by pressing the **End** key to put the H-ADCP in command mode. When the H-ADCP receives a BREAK signal, it responds with a wake-up message similar to the one shown below. The H-ADCP is now ready to accept commands at the ">" prompt from either a terminal or computer program.

```
[BREAK Wakeup A]
WorkHorse Horizontal Broadband H-ADCP Version 11.08
RD Instruments (c) 1996-2004
All Rights Reserved.
>
```



NOTE. If you use a terminal/program other than *BBTalk*, the BREAK length (up to down transition) must last at least 300 ms.

9.1.1 Command Input Processing

Input commands set H-ADCP operating parameters, start data collection, run built-in tests (BIT), and asks for output data. All commands 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 H-ADCP executes the command. If the command is one that does not provide output data, the H-ADCP sends a carriage return line feed <CR> <LF> and displays a new “>” prompt. Continuing the example,

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



NOTE. Leading zeros are not required. Sending WP00001 and WP1 set the number of pings to 1.

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

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

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

After correctly entering all the commands for your application, you would send the CS-command to put the H-ADCP into the ping mode and begin the data collection cycle.

9.1.2 Data Output Processing

After the H-ADCP completes a data collection cycle, it sends a block of data called a *data ensemble*. A data ensemble consists of the data collected and averaged during the ensemble interval (see [TE – Time per Ensemble](#)). A data ensemble can contain header, leader, velocity, correlation magnitude, echo intensity, percent good, and status data.

H-ADCP output data can be in either hexadecimal-ASCII (Hex-ASCII) or binary format (set by [CF - Flow Control](#)). The Hex-ASCII mode is useful when you use a terminal to communicate with, and view data from the H-ADCP. The binary mode is useful for high-speed communication 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.



NOTE. All of Teledyne RD Instruments' software supports binary PDO Output Data Format only.

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

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

9.2 Firmware Updates

The firmware for H-ADCPs is located on flash memory chips on the CPU board. New firmware must be downloaded. To download new firmware, do the following steps.

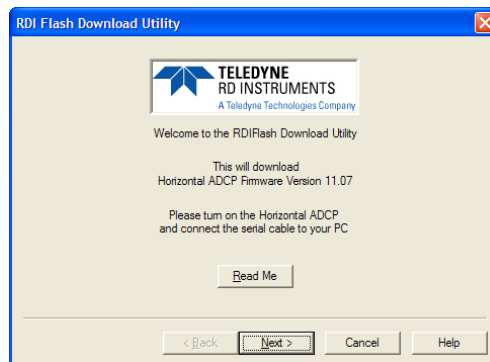


NOTE. The CPU board must have EEPROM Parts installed to install version 16.xx or higher firmware. The firmware upgrade program checks if the H-ADCP is capable of upgrading to the new version of firmware.

- a. Set up the H-ADCP as shown in Figure 3.
- b. Start the program WHx.exe (where x = the firmware version). Click **Setup**.



Figure 31. Firmware Update



- c. Click the **Read Me** button to view the Readme.txt file for details on what is new in this version of firmware. Click **Next**.

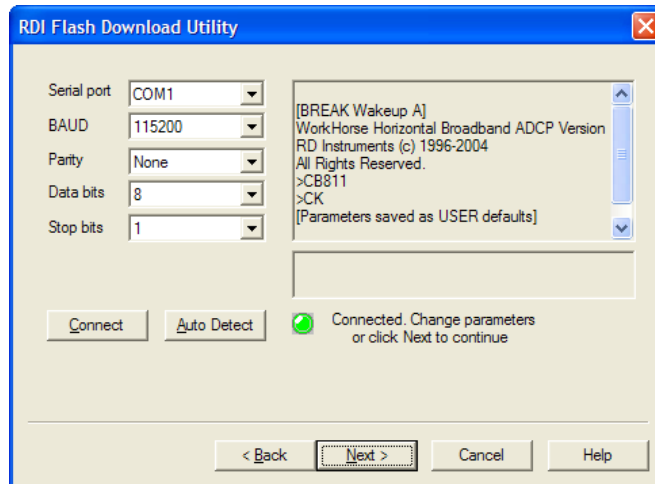


Figure 32. RDIFlash Firmware Upgrade Utility Screen

- d. Enter the **Serial port** and then click **Connect**.
- e. Click **Next** and follow the on-screen prompts.
- f. If you are not able to install the new version of firmware, contact Customer Service (see [How to Contact Teledyne RD Instruments](#)) for assistance.
- g. After successfully upgrading the firmware, use *BBTalk* to test the H-ADCP.

9.3 Feature Upgrades

The Horizontal H-ADCP (H-ADCP) includes Water Profiling, Bottom Track, and the High Resolution Water-Profiling modes. The 300 kHz Narrow Beam Width H-ADCP can be upgraded to identify itself as a wave gauge for use with *WavesMon* and *WaveView*. The feature upgrade installation program is used to install Waves capabilities in an H-ADCP.



NOTE. Contact your local sales representative if you are interested in upgrading your system.



NOTE. The upgrade disk is specific to the unit for which it was ordered.



NOTE. Many feature upgrades require the latest firmware version to be installed in your H-ADCP. If you need to update the firmware, do this before installing the feature upgrade (see [Firmware Updates](#)).

- a. Set up the H-ADCP as shown in Figure 3.
- b. Place the feature upgrade disk in the disk drive (usually the “A” drive).
- c. Click the Windows **Start** button, and then select **Run**.
- d. In the **Open** box, type A:xxx.exe, where xxx is the H-ADCP’s CPU serial number. The installation program will start (see Figure 33). The program is encoded with the H-ADCP’s serial number and the requested feature upgrade.

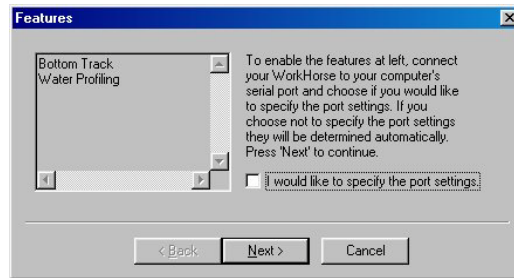


Figure 33. Installing Feature Upgrades

- e. To select the port settings, select the **I would like to specify the port setting** box and click **Next**.
- f. Select the **Serial Port** and **Baud Rate**.
- g. Click **Next** to install the feature upgrade. Click **Finish** to exit the program.

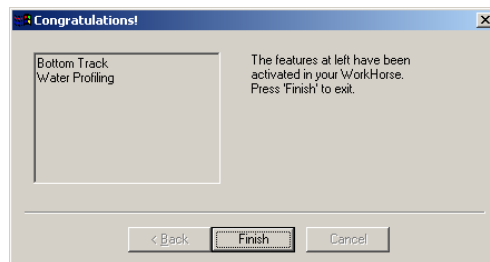


Figure 34. Feature Upgrade Completed

- h. Start *BBTalk* and use the OL command (see [OL - Features](#)) to verify the feature upgrade has been installed.

9.4 Using Direct Commands to Deploy your H-ADCP

TRDI recommends that you use our software programs *WinH-ADCP* as your primary method of deployment. If this is not possible in your deployment then we ***strongly recommend*** that the commands shown in Table 17 be the ***minimum*** commands you send to the instrument.



CAUTION. TRDI does not recommend the use of direct commands as your primary way of deploying H-ADCPs as **any incorrect command setting can have severe consequences to your data collection.**

Table 17: ADCP Minimum Required Commands for Deployments

Command	Description
CR1	This command will set your H-ADCP to a known factory default setting and must be your first command
Special commands here –after CR1 command and before any other commands	
CFxxxx	This command will set your H-ADCP collection mode; binary, recorder, etc.
EAxxxx	This command will set your magnetic compass offset for true north
EDxxx	This command will set your H-ADCP depth
ESxx	This command will set your H-ADCP's expected salinity
EXxxxx	This command will set your H-ADCP's coordinate system; earth, beam, etc.
EZxxxxxx	This command will set what sensors will be used by your H-ADCP; heading, pitch, roll, temp, etc.
WBx	This command will set the water profile bandwidth between wide (0) and narrow (1)
WNxx	This command will set the number of depth cells to collect
WPxx	This command will set the number of pings to average
WSxxxx	This command will set the depth cell size to use
TExxxxxxx	This command will set the time between ensembles
TPxxxxxx	This command will set the time between pings
CK	This command will save your setup to the internal RAM and must be your second to last command
CS	This command will start your deployment and must be your last command



CAUTION. Although these are our recommended minimum commands, **they may not be the only commands you need for your deployment to be successful!**



NOTE. Your deployment may require additional commands and these commands can be sent after the CR1 and any special commands but must be placed before the CK command.

9.5 Command Summary

Table 18 gives a summary of the H-ADCP input commands, their format, and a brief description of the parameters they control. Table 19 lists the factory default command settings.



NOTE. This table shows all commands including optional feature upgrades and expert commands. To see the expert commands, you must first send the command EXPERTON. **Some commands may not be available for your H-ADCP.**



NOTE. When newer firmware versions are released, some commands may be modified or added. Read the README file on the upgrade disk or check TRDI's web site for the latest changes.

Table 18: H-ADCP Input Command Summary

Command	Description
?	Shows command menu (deploy or system)
<BREAK> End	Interrupts or wakes up H-ADCP and loads last settings used
EXPERTON	Turns expert mode on. All commands will be listed
EXPERTOFF	Turns expert mode off.
OL	List features/special firmware upgrades that are installed
AC	Output calibration data
AD	Display factory calibration
AF	Field calibrate compass to remove hard iron error
AR	Return to factory calibration
AX	Examine compass performance
AZ	Zero pressure sensor
BA nnn	Evaluation amplitude minimum (1 to 255 counts)
BB $nnnn$	High Bandwidth Maximum Depth (dm)
BC nnn	Correlation Magnitude minimum (0 to 255 counts)
BE $nnnn$	Error velocity maximum (0 to 9999 mm/s)
BF $nnnn$	Depth guess (1 to 65535 dm, 0 = automatic)
BG $ss,dd,nnnnn$	
BH ccc,sss,lll,mmm	
Bl nnn	Gain switch depth (0 to 999 meters)
BK n	Water-mass Layer Mode (0-Off, 1-On, 2-Lost, 3-No BT)
BL $mmm,nnnn,ffff$	Water mass layer parameters: Min Size (dm), Near (dm), Far (dm)
BM n	Bottom track mode (5 = Default, 4 = Default minus Coherent)
BP nnn	Bottom Track Pings per Ensemble
BR n	Resolution (0 = 4%, 1 = 2%, 2 = 1%)
BS	Clear distance traveled
BX $nnnn$	Maximum Tracking Depth (40 to 65535 dm)
BZ nnn	Coherent ambiguity velocity (cm/s radial)
CB nnn	Serial port control (baud rate/parity/stop bits)
CF $nnnn$	Flow control
CK	Keep parameters as user defaults
CL n	Sleep between Pings (0 = No, 1 = Yes)
CM n	Not used.
CN n	Save NVRAM to recorder (0 = On, 1 = Off)
CP n	Polled mode (0 = Off, 1 = On)
CQ nnn	Transmit power (0 = Low, 1 to 255 = High)
CR n	Retrieve parameters (0 = User, 1 = Factory)
CS or Tab	Start pinging
CY n	Clear error status word (0 = Clear, 1 = Display)
CZ	Power down H-ADCP

Continued Next Page

Table 18: H-ADCP Input Command Summary (continued)

Command	Description
DBx,y,z	RS-485 port control
DS	Load speed of sound with SVSS sample
DWx	Current ID on RS-485 bus (0 to 31)
DX	Set SVSS to raw mode
DY	Set SVSS to real mode
DZ	Get single scan from SVSS
EA±nnnn	Heading alignment (-179.99 to 180.00 degrees)
EB±nnnn	Heading bias (-179.99 to 180.00 degrees)
ECnnnn	Speed of Sound (1400 to 1600 m/s)
EDnnnn	Transducer Depth (0 to 65535 dm)
EHnnnn	Heading (000.00 to 359.99 degrees)
EP±nnnn	Pitch (-60.00 to +60.00 degrees)
ER±nnnn	Roll (-60.00 to +60.00 degrees)
ESnn	Salinity (0 to 40)
ET±nnnn	Temperature (-5.00 to +40.00 degrees C)
EXnnnn	Coordinate Transformation (Xform:Type; Tilts; 3Bm; Map)
EZnnnnnn	Sensor Source (C;D;H;P;R;S;T)
FC	Clear Fault Log
FD	Display Fault Log
HAAnn	Waves false target threshold (fish rejection)
HBnn	Number of automatically chosen bins (20 Max)
HDnnn nnn nnn	Waves selected data (Vel;Pres;Surf ;; ;;)
HFnnnnn	Waves Flow Control (Res;Res;Res;Ser;Rec)
HPnnnn	Number of pings per record
HRhh:mm:ss.ff	Time between wave bursts (hh:mm:ss.ff)
HSnnn,nnn,nnn,nnn,nnn	Bins selected for directional wave data recording
HThh:mm:ss.ff	Time between wave pings (hh:mm:ss.ff)
HVnnn,nnn,nnn,nnn,nnn	Bins selected for velocity spectrum data recording
PA	Pre-deployment tests
PC1	Beam Continuity Built-in test
PC2	Display Heading, Pitch, Roll, and Orientation Built-in test
PDnn	Data stream select (0-6,8,14)
PM	Distance measurement facility
PS0	Display System Configuration
PS3	Display Instrument Transformation Matrix
PTnnn	Built-In test (0 to 200)
RA	Number of deployments
RB	Recorder built-in test
RE ErAsE	Erase recorder
RF	Recorder free space (Bytes)
RN	Set deployment name
RR	Show recorder file directory
RS	Recorder free space (Megabytes)
RY	Upload recorder files
SAxyz	Synchronize before/after ping/ensemble
SBx	Enable Channel B Breaks (1 = YES, 0 = NO)
Slnnnn	Synchronization interval (0 to 65535 s)
SMn	RDS3 mode select (0 = Off, 1 = Master, 2 = Slave)
SSx	RDS3 sleep mode (0 = No Sleep, 1 = Sleep)
STn	Slave timeout (0 to 10800 seconds)
SWn	Synchronization delay (0m to 65535 (1/10 milliseconds))

Table 18: H-ADCP Input Command Summary (continued)

Command	Description
TBhh:mm:ss.ff	Time per burst
TCnnnn	Ensemble per burst (0 to 65535)
TEhh:mm:ss.ff	Time per ensemble (hours:minutes:seconds.100 th of seconds)
TFyy/mm/dd, hh:mm:ss	Time of first ping (year/month/day, hours:minutes:seconds)
TGccyy/mm/dd, hh:mm:ss	Time of first ping (Y2k compatible) (century year/month/day, hours:minutes:seconds)
TPmm:ss.ff	Time between pings (minutes:seconds.100 th of seconds)
TSyy/mm/dd, hh:mm:ss	Set real-time clock (year/month/day, hours:minutes:seconds)
TTccyy/mm/dd, hh:mm:ss	Set real-time clock (Y2k compatible) (century year /month/day, hours:minutes:seconds)
WAnnn	False target threshold maximum (0 to 255 counts)
WBn	Mode 1 Bandwidth Control (0 = Wide, 1 = Narrow)
WCnnn	Low correlation threshold (0 to 255 counts)
WDnnn nnn nnn	Data Out (Vel;Cor;Amp PG;St;P0 P1;P2;P3)
WEnnnn	Error correlation threshold (0 to 5000 mm/s)
WFnnnn	Blank after transmit (0 to 9999 cm)
WIn	Clip data past bottom (0 = Off, 1 = On)
WJn	Receiver gain select (0 = Low, 1 = High)
WLsss,eee	Water reference layer
WNnnn	Number of depth cells (1 to 128)
WPnnnn	Pings per ensemble (0 to 16384)
WQn	Sample ambient sound (0 = Off, 1 = On)
WSnnnn [min, max]	Depth cell size, 20 to 800 (300kHz), 10 to 800 (600kHz)
WTnnnn	Transmit length (0 to 3200 cm)
WUn	Ping weight (0 = Box, 1 = Triangle)
WVnnn	Ambiguity velocity (002 to 480 cm/s radial)
WWnnn	Mode 1 Pings before Mode 4 Re-acquire
WYn,nnn	WM 1: Bandwidth (0=WB, 1=NB), Amb. Vel.(cm/s)

Table 19: H-ADCP Factory Defaults

Command	300 kHz	600 kHz
BA	30	30
BB	320	160
BC	220	220
BE	1000	1000
BF	0	0
BG		
BH		
BI	20	10
BK	0	0
BL	160,320,480	80,160,240
BM	5	5
BP	0	0
BR	1	1
BX	350	150
BZ	4	4
CB	411	411
CF	11110	11110
CL	1	1
CM	0	0
CN	1	1
CP	0	0
CQ	255	255
DB	611	611
DW	0	0
EA	+0	+0
EB	+0	+0
EC	1500	1500
ED	0	0
EH	0	0
EP	+0	+0
ER	+0	+0
ES	0	0
ET	+2500	+2500
EX	01110	01110
EZ	1111101	1111101
HA	255	255
HB	5	5
HD	111 000 000	111 000 000
HF	00000	00000
HP	0	0
HR	01:00:00.00	01:00:00.00
HS	001,010,021,022,023	001,010,021,022,023
HT	00:00:00.50	00:00:00.50
HV	001,010,021,022,023	001,010,021,022,023
PD	0	0

Continued Next Page

Table 19: H-ADCP Factory Defaults (continued)

Command	300 kHz	600 kHz
SA	001	001
SB	1	1
SI	0	0
SM	0	0
SS	0	0
ST	0	0
SW	0	0
TB	00:00:00.00	00:00:00.00
TC	0	0
TE	00:00:00.00	00:00:00.00
TP	00:01.00	00:00.20
WA	255	255
WB	1	1
WC	64	64
WD	111 100 000	111 100 000
WE	1500	1500
WF	175	100
WI	0	0
WJ	1	1
WL	0,5	0,5
WN	30	30
WP	30	30
WQ	0	0
WS	800 [20,1600]	400 [10,800]
WT	0	0
WU	0	0
WV	185	185
WW	4	4
WY	1,185	1,185



NOTE. The highlighted commands have frequency dependent defaults.

10 Command Descriptions

Each listing includes the command's purpose, format, default setting (if applicable) range, recommended setting, and description. When appropriate, we include amplifying notes and examples. If a numeric value follows the command, the H-ADCP uses it to set a processing value (time, range, percentage, processing flags). All measurement values are in metric units (mm, cm, and dm).

? – Help Menus

Purpose	Lists the major help groups.
Format	<i>x?</i> (see description)
Description	Entering <u>?</u> by itself displays all command groups. To display help for one command group, enter <u><i>x?</i></u> , where <i>x</i> is the command group you wish to view. When the H-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 followed by a question mark. For example, to view the WP-command setting enter <u>WP?</u> .
Examples	See below.

```
[BREAK Wakeup A]
```

```
WorkHorse Broadband H-ADCP Version 16.xx
Teledyne RD Instruments (c) 1996-2005
All Rights reserved.
>?
Available Menus:
DEPLOY? ----- Deployment Commands
SYSTEM? ----- System Control, Data Recovery and Testing Com-
mands

Available Commands:

C? ----- CONTROL Commands
E? ----- ENVIRONMENTAL SENSORS Commands
P? ----- PERFORMANCE Commands
S? ----- RDS^3 SYNCHRONIZATION Commands
T? ----- TIMING Commands
W? ----- WATER PROFILING Commands
R? ----- RECORDER Commands
A? ----- SENSOR/COMPASS Commands
O? ----- FEATURE Commands
D? ----- APPLIED MICROSYSTEMS Commands
?? ----- DISPLAY Quick Menus
>
```

Break

Purpose	Interrupts H-ADCP without erasing present settings.
Format	<BREAK>



Recommended Setting. Use as needed.

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

Example <BREAK>

```
[BREAK Wakeup A]
WorkHorse Broadband H-ADCP Version 16.xx
Teledyne RD Instruments (c) 1996-2000
All Rights reserved.
>?
```

When you send a break the text inside the brackets '[...]' of the first line of the Wakeup Messages indicates the H-ADCP's communication configuration:

- **[BREAK Wakeup A]** => H-ADCP is set to send/receive RS232 communication through the serial lines of the I/O cable
- **[BREAK Wakeup B]** => H-ADCP is set to send/receive RS432 communication through the serial lines of the I/O cable.
- **[BREAK Wakeup AB]** => RS232/422 switch on the top of the PIO board in the H-ADCP is in between two positions, but neither RS232 nor RS422. It can also mean that the H-ADCP received a trigger pulse while in command mode.
- **[ALARM Wakeup A]** => When you send a break, if the input voltage has a low voltage reading you will get the following message:

```
[ALARM Wakeup A]
WorkHorse Broadband H-ADCP Version 16.xx
Teledyne RD Instruments (c) 1996-2005
All Rights Reserved.
>
```



CAUTION. If this message appears after a break, it is advised not to deploy the H-ADCP since TRDI cannot guarantee the unit will perform to the performance specifications.

Software Breaks can be used with *WinRiver*. Start *WinRiver* in the Acquire mode. If you are in the Playback mode, click **File, Acquire Mode**. To open the **Communications Settings** dialog box, click **Settings, Communications**.

Click the **Properties** button, **General** tab and select the **Use Software Breaks** box. The H-ADCP will use the "===" string instead of a break. Only H-ADCP firmware 11.04 and above accepts this option.

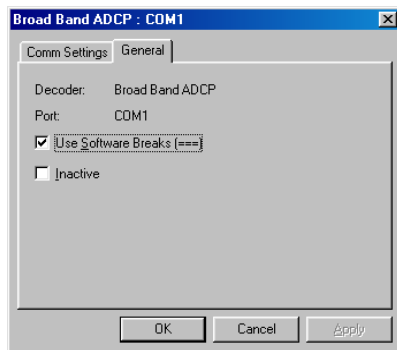


Figure 35. Software Break Setup in *WinRiver*



NOTE. In order for the software breaks to work, the CL command must be set to CL0 (see [CL - Battery Saver Mode](#)).

Expert Mode

Purpose Turns on or off the expert mode.
Format expertoff, experton



Recommended Setting. Use as needed.

Description When the Expert Off command is used, it limits the amount of commands displayed on the help menu. When the expert mode is turned off, all commands are still available (to ensure software compatibility) but do not display. The Expert On command shows all of the available commands in the help menu.

Examples See below.

```
expertoff
Expert Mode is Off
>
experton
Expert Mode is On
>
```

OL - Features

Purpose Lists special firmware upgrades that are installed.

Format OL



Recommended Setting. Use as needed.

Description Lists special features that are installed. See [Feature Upgrades](#) for information on how to install additional capability in your H-ADCP.

Examples See below.

```
>ol                                FEATURES
-----
Feature                           Installed
-----
Bottom Track                      Yes
Water Profile                     Yes
High Resolution Water Modes       No
Lowered H-ADCP                   No
Waves Gauge Acquisition           No
See your technical manual or contact TRDI for information on how to
install additional capability in your H-ADCP.
```

10.1 Compass Commands

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

10.1.1 Available Compass Commands

This section lists the available compass commands.

```
>a?
Available Commands:

AC ----- Output Active Fluxgate & Tilt Calibration Data
AD ----- Display Calibration Data
AF ----- Field Calibrate to remove Hard and/or Soft Iron Error
AR ----- Restore Factory Fluxgate Calibration data:
           make factory the active calibration data
AX ----- Examine Compass Performance
AZ  0.000000 ----- Zero pressure reading
A? ----- Display Public Sensor Commands

>
```

10.1.2 Compass Command Descriptions

AC – Output Active Calibration Data

Purpose Outputs active fluxgate and tilt calibration data.

Format AC



Recommended Setting. Use as needed.

Description The AC command is identical to the AD command except that the AC command doesn't prompt the user for Factory or Active Calibration data; it assumes active. The AC Command doesn't prompt the user to "press any key to continue..." when the screen is full.

Example See below

```
>ac

ACTIVE FLUXGATE CALIBRATION MATRICES in NVRAM
Calibration date and time: 4/6/2000 11:00:29
S inverse
+
Bx | 2.8071e-01 -2.8343e-01 -3.8045e-02 1.1574e-02 |
By | 8.6383e-04 1.8275e-03 -3.8555e-01 2.9522e-03 |
Bz | -1.3365e-01 -1.2769e-01 4.9614e-03 -2.2870e-01 |
Err | 3.5561e-01 3.3613e-01 -6.3830e-04 -3.9550e-01 |
+

Coil Offset
+
| 3.4253e+04 |
| 3.5362e+04 |
| 3.5650e+04 |
| 3.3749e+04 |
+

Electrical Null
+
| 34575 |
```

TILT CALIBRATION MATRICES in NVRAM							
Calibration date and time: 4/6/2000 10:58:42							
Average Temperature During Calibration was 26.6 °C							
Up				Down			
Roll	+	-3.2219e-07	-1.1456e-05	+	+	4.2529e-07	1.6306e-05
Pitch		-1.1477e-05	8.4276e-08			-1.6188e-05	1.9917e-07
	+			+	+		
Offset	+	3.2400e+04	3.2470e+04	+	+	3.0128e+04	3.2002e+04
	+			+	+		
		Null	33336				

AD – Display Factory or Active Calibration Data

Purpose	Displays factory calibration or active calibration data.
---------	--

Format	AD
--------	----



Recommended Setting. Use as needed.

Description	Displays factory calibration or active calibration data.
-------------	--

Example >AD

```
Display factory calibration data or active calibration data [f or a]?a
```

```

ACTIVE FLUXGATE CALIBRATION MATRICES in FLASH
  Calibration date and time: 3/8/1996   09:53:42
      S inverse
Bx      2.9102e-01  2.6325e-01  2.1267e-02  4.0145e-01
By      2.7342e-01  2.5335e-01 -4.8691e-02 -3.9508e-01
Bz     -1.8192e-01  2.0180e-01  2.3319e-01 -2.7045e-02
Err      3.9761e-01 -3.9925e-01  6.4865e-01 -6.0795e-02

      Coil Offset
      3.5076e+04
      3.3277e+04
      3.2996e+04
      3.3953e+04

      Electrical Null
      33901
      press any key to continue...

```

TILT CALIBRATION MATRICES in FLASH					
Calibration date and time: 12/28/1995 08:13:29					
Average Temperature During Calibration was 23.4° C					
	Up			Down	
Roll		-2.1990e-05	-2.8379e-05		2.6648e-05 3.4953e-05
Pitch		-2.9185e-05	2.2630e-05		-3.5895e-05 2.8521e-05

Offset	3.1747e+04	3.0144e+04		3.0434e+04	3.2971e+04
		Null	33408		

AF – Field Calibrate Compass

Purpose	Calibrates the compass to remove hard and soft iron effects.
---------	--

Format	AF
--------	----



Recommended Setting. Use as needed. The compass must be calibrated if the batteries have been replaced.

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

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



NOTE. For details on compass alignment, see [Compass Calibration](#).

AR – Return to Factory Calibration

Purpose Returns to the factory calibration matrix.
Format AR



Recommended Setting. Use as needed.

Description If the calibration procedure is not successful (AF-command), return your H-ADCP to the original factory calibration, by using the AR-command. Try using the AR-command if you have trouble calibrating your compass. In some circumstances, a defective compass calibration matrix can prevent proper calibration.

AX – Examine Compass Calibration

Purpose Used to verify the compass calibration.
Format AX



Recommended Setting. Use as needed.

Description Compass calibration verification is an automated built-in test that measures how well the compass is calibrated. The procedure measures compass parameters at every 5° of rotation for a full 360° rotation. When it has collected data for all required directions, the H-ADCP computes and displays the results. Pay particular attention to the Overall Error.

Example >AX

```
-----
                      TRDI Compass Error Estimating Algorithm

Press any key to start taking data after the instrument is setup.
Rotate the unit in a plane until all data samples are acquired...
rotate less than 5°/sec. Press Q to quit.

  N      NE      E      SE      S      SW      W      NW      N
  ^              ^              ^              ^              ^
*****
Accumulating data ...
Calculating compass performance ...

                      >>> Total error:   1.5° <<<

Press D for details or any other key to continue...

HEADING ERROR ESTIMATE FOR THE CURRENT COMPASS CALIBRATION:

OVERALL ERROR:
  Peak Double + Single Cycle Error (should be < 5°):  ± 1.55°
```

DETAILED ERROR SUMMARY:

Single Cycle Error:	$\pm 1.54^\circ$
Double Cycle Error:	$\pm 0.07^\circ$
Largest Double plus Single Cycle Error:	$\pm 1.61^\circ$
RMS of 3rd Order and Higher + Random Error:	$\pm 0.31^\circ$

Orientation:	Down		
Average Pitch:	-19.29°	Pitch Standard Dev:	0.28°
Average Roll:	-0.59°	Roll Standard Dev:	0.31°

Successfully evaluated compass performance for the current compass calibration.
Press any key to continue...

AZ – Zero Pressure Sensor

Purpose Zeros the pressure sensor.

Format AZ



Recommended Setting. Use as needed.

Description This command zeros the pressure sensor at the specific location where the H-ADCP will be used.



NOTE. If the pressure sensor is not installed, using the AZ command will generate the following error.

Err: No pressure sensor detected

10.2 Bottom Track Commands

The H-ADCP uses these commands for bottom-tracking applications. Bottom track commands tell the H-ADCP to collect speed-over-bottom data and detected range-to-bottom data. If the H-ADCP were facing UP, all bottom-track information would apply to the surface boundary instead of the bottom boundary. The default state of bottom tracking is off for H-ADCPs (BP0).

10.2.1 Available Bottom Track Commands

This section lists the most often used Bottom Track commands.

```
>b?
BA = 030 ----- Evaluation Amplitude Min (1-255)
BB = 0060 ----- High Bandwidth Maximum Depth (dm)
BC = 220 ----- Correlation Magnitude Min (0-255)
BE = 1000 ----- Max Error Velocity (mm/s)
BF = 00000 ----- Depth Guess (0=Auto, 1-65535 = dm)
BG = 80,20,00030 ----- BM6 Shal Xmt (%), Deep Xmt (%), Deep (dm)
BH = 190,010,004,040 ----- BM6 Thresh(cnt), S Amb(cm/s), L Amb(cm/s), MinAmb
BI = 005 ----- Gain Switch Depth (0-999 meters)
BK = 0 ----- Layer Mode (0=Off Only, Disabled)
BL = 040,0060,0100 ----- Layer: Min Size (dm), Near (dm), Far (dm)
BM = 5 ----- Mode (4 wo/PP, 5 w/PP)
BP = 000 ----- Pings per Ensemble
BR = 0 ----- Resolution (0 = 4%, 1 = 2%, 2 = 1%)
BS ----- Clear Distance Traveled
BX = 00040 ----- Maximum Depth (40-65535 dm)
BZ = 004 ----- Coherent Ambiguity Velocity (cm/s radial)
>
```

10.2.2 Bottom Track Command Descriptions

BA - Evaluation Amplitude Minimum

Purpose	Sets the minimum value for valid bottom detection.
Format	BA nnn
Range	$nnn = 1$ to 255 counts
Default	BA30



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.

BB – High Bandwidth Maximum Depth

Purpose	This command lets the user define the depth at which the H-ADCP switches between 25% and 50% bandwidth.
Format	BBnnnn
Range	nnnn = 0 to 9999 dm
Default	B320 (300 kHz), BB160 (600 kHz)



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

Description	This command lets the user define the depth at which the H-ADCP switches between 25% and 50% bandwidth. A setting of zero disables 50% bandwidth. A setting of 9999 disables 25% bandwidth.
-------------	---

BC - Correlation Magnitude Minimum

Purpose	Sets minimum correlation magnitude for valid velocity data.
Format	BCnnn
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 H-ADCP flags as bad any bottom-track data with a correlation magnitude less than this value.
-------------	---



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

BE - Error Velocity Maximum

Purpose	Sets maximum error velocity for good bottom-track data.
Format	BEnnnn
Range	nnnn = 0 to 9999 mm/s
Default	BE1000



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



CAUTION. The default setting is set purposely high and as a result effectively disabled. We recommend extreme caution and testing before changing this setting. **Data rejected by this command is lost and cannot be regained.**

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

BF - Depth Guess

Purpose Sets a “best-guess” of expected bottom range for internal calculations.

Format BFnnnnnn

Range nnnnnn = 1 to 65535 dm (0 = automatic)

Default BF0



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

Description When set to a non-zero value, the H-ADCP transmits a fixed pulse based on a given bottom range. This is useful for applications with fixed range bottoms. The command reduces the amount of time the H-ADCP uses to search for the bottom if lost.



CAUTION. If improperly set, the H-ADCP may not bottom-track at all if the bottom range varies from the input range.

BI - Gain Switch Depth

Purpose Selects the maximum vertical distance from the transducer to the bottom at which the H-ADCP operates at low gain.

Format BI nnn

Range nnn = 0 to 999 meters

Default BI20 (300 kHz), BI10 (600 kHz),



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

Description When the vertical range to the bottom is less than BI, the unit operates in low gain. When the vertical range is greater than

BI, internal logic determines which gain (low or high) is optimal. In high backscatter areas, it may be necessary to raise this setting in order to detect bottom throughout the range of the system.

BK – Water-Mass Layer Mode

Purpose	Selects the ping frequency of the water-mass layer ping
Format	BK <i>n</i>
Range	<i>n</i> = 0
Default	BK0



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

Description BK selects how often the H-ADCP performs a water-mass layer ping while bottom tracking. The number of water-mass layer pings per ensemble is dependent on the BP-command (bottom pings per ensemble) and this command setting. Use the BL-command to set the location of the water-mass layer.

Table 20: Water-Mass Reference-Layer Modes

Command	Description
BK0	Disables the water-mass layer ping.
BK1	N/A
BK2	N/A
BK3	N/A

BL - Water-Mass Layer Parameters

Purpose	Sets bottom-track water-mass layer boundaries and minimum layer size.
Format	BL <i>mmm,nnnn,ffff</i>
Range	<i>mmm</i> = Minimum Layer Size (0 to 999 decimeters) [meters x 10] <i>nnnn</i> = Near Layer Boundary (0 to 9999 decimeters) [meters x 10] <i>ffff</i> = Far Layer Boundary (0 to 9999 decimeters) [meters x 10]
Default	BL160,320,480 (300 kHz), BL80,160,240 (600 kHz)



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

Description The BL-command sets a water-mass layer. You can use this layer as a reference point when the bottom is out of range or is incorrect. Water-mass layer output data are available when both BK - Water-Mass Layer Mode and BP - Bottom-Track

Pings Per Ensemble are nonzero values, and the bottom must be at least the Minimum Layer Size + Near Layer Boundary + 20% of the reported depth away from the transducer. The Far Layer Boundary (ffff) must be less than the maximum profiling distance or the H-ADCP sends Error Code 011.

The user-defined water-mass layer is used unless the layer comes within 20% of the water boundary (sea floor for down-looking systems; surface for up-looking systems). As the user-defined water-mass layer comes within 20% of the boundary (Figure 36, B), the layer compresses in size until the minimum water-mass layer size is reached. When the boundary moves closer to the transducer (Figure 36, C), no water mass ping will be sent.



NOTE. The water-mass layer is operational only if BP > zero and BK > zero.

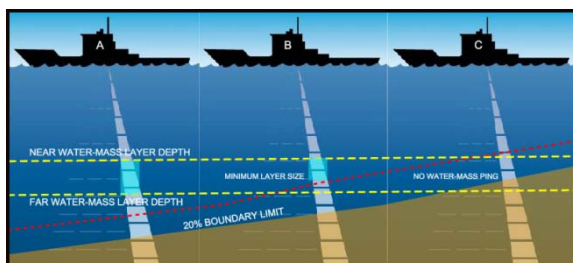


Figure 36. Water-Mass Layer Processing

BM - Bottom Track Mode

Purpose	Sets the Bottom Track mode.
Format	BM n
Range	$n = 4, 5$, (see description)
Default	BM5



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

Description See below

Bottom Track Mode 4

Bottom Track Mode 4 uses the correlation side-peak position to resolve velocity ambiguities. It lengthens the lag at a pre-determined depth to improve variance.

Bottom Track Mode 5

Bottom Track Mode 5 is similar to Bottom Track Mode 4, but has a lower variance in shallow water by a factor of up to four. In very shallow water at slow speeds, the variance is lower by a factor of up to 100. Bottom Track Mode 5 also has a slightly slower ping rate than Bottom Track Mode 4.



NOTE. Bottom Mode 5 (default setting) will shift to Bottom Mode 4 if the conditions warrant.

The H-ADCP limits searching for the bottom to the value set by the BX-command (max bottom tracking altitude) + 0.5 transmit length. This allows a faster ping rate when the bottom altitude is close to the BX-command setting.

Table 21: BM4/BM5 Minimum Tracking Depths

Frequency (kHz)	BM4/BM5 Minimum Tracking Depths (m)
300	1.5
600	1.0

BP – Bottom-Track Pings per Ensemble

Purpose	Sets the number of bottom-track pings to average together in each data ensemble.
Format	BP nnn
Range	$nnn = 0$ to 999 pings
Default	BP0



NOTE. In firmware versions 11.06 and earlier, the default is BP1.



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.
-------------	---



NOTES.

The H-ADCP interleaves bottom-track pings with water-track pings (see [TP – Time Between Pings](#)). If BP = zero, the H-ADCP does not collect bottom-track data. The H-ADCP automatically extends the ensemble interval (TE) if $BP \times TP > TE$.

BR - Resolution

Purpose	Sets the vertical depth resolution.
Format	BRn
Range	n = 0 to 2 (see description)
Default	BR1



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

Description BR sets the vertical depth resolution as a percentage of the overall range detected; the lower the resolution, the finer the depth reading. With BR0 set, if you had a depth of 100 meters, then the depth would read 100 meters until you passed 104 meters. If you had BR2 set, then it would change when you reached 101 meters. Setting a higher resolution (e.g. 1%) results in longer ping times.

BR0 = 4% BR1 = 2% BR2 = 1%

Resolution Setting Limitations:

1) Minimum RSSI Bin Size – The RSSI sampling interval cannot be smaller than the minimum RSSI bin size (for example, 5 cm for a 1200 kHz system). This means that you get the resolution that you command in % or 5 cm (for the above example) - whichever is larger. The minimum RSSI bin sizes vary with system frequency according to the following table:

Frequency	Min RSSI Bin Size
300	18 cm
600	9 cm

2) BM5 Low Altitude Minimum RSSI Bin Size -- This limitation affects only Bottom Mode 5 operation below the following altitudes:

300 kHz -- 10 meters -- the resolution becomes 16 cm

600 kHz -- 5 meters -- the resolution becomes 8 cm

BS - Clear Distance Traveled

Purpose	Clears internal distance traveled accumulators.
Format	BS



Recommended Setting. Use as needed.

Description Distance traveled is calculated and output in DVL output formats (PD5 and PD6). The accumulator is zeroed on

<BREAK> or by using this command in the manual ensemble cycling mode.

BX – Maximum Tracking Depth

Purpose	Sets the maximum tracking depth in bottom-track mode.
Format	BXnnnn
Range	nnnn = 10 to 65535 decimeters (meters x 10)
Default	BX350 (300 kHz), BX150 (600 kHz)



Recommended Setting. Set BX to a depth slightly greater than the expected maximum depth.

Description The BX-command sets the maximum tracking depth used by the H-ADCP during bottom tracking. This prevents the H-ADCP from searching too long and too deep for the bottom, allowing a faster ping rate when the H-ADCP loses track of the bottom. If the bottom-track water reference layer is in use (BK > 0), BX must be greater than the Far Layer Boundary (BLmmm,nnnn,ffff), or the H-ADCP sends Error Code 012.

Example If you know the maximum depth in the deployment area is 20 meters (200 decimeters), set BX to a value slightly larger than 200 dm, say 210 dm, instead of the default 350 dm for a 300 kHz H-ADCP. Now if the H-ADCP loses track of the bottom, it will stop searching for the bottom at 210-dm (21 m) rather than spend time searching down to 350-dm (35 m).

BZ - Coherent Ambiguity Velocity

Purpose	Sets the Bottom-Track Mode 5 ambiguity velocity.
Format	BZnnn
Range	nnn = 2 to 160 cm/s radial
Default	BZ4



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

Description The BZ-command selects the ambiguity velocity used by the bottom-track ping in shallow water when bottom-track Mode 5 is in use.

10.3 Control System Commands

The H-ADCP uses the following commands to control certain system parameters.

10.3.1 Available Control System Commands

This section lists the available Control System commands.

```
>c?
CB = 411 ----- Serial Port Control (Baud [4=9600]; Par; Stop)
CB = 811 ----- Serial Port Control (Baud [8=115200]; Par; Stop)
CF = 11110 ----- Flow Ctrl (EnsCyc;PngCyc;Binry;Ser;Rec)
CK ----- Keep Parameters as USER Defaults
CL = 1 ----- Sleep Enable (0 = Disable, 1 = Enable)
CM = 0 ----- RS-232 Sync Master (0 = OFF, 1 = ON)
CN = 1 ----- Save NVRAM to recorder (0 = ON, 1 = OFF)
CP = 0 ----- PolledMode (1=ON, 0=OFF; BREAK resets)
CQ = 255 ----- Xmt Power (0=Low, 255=High)
CR # ----- Retrieve Parameters (0 = USER, 1 = FACTORY)
CS ----- Go (Start Pinging)
CY # ----- Error Status Word (0=Clear, 1=Display)
CZ ----- Power Down Instrument
>
```

10.3.2 Control System Command Descriptions

CB - Serial Port Control

Purpose	Sets the RS-232/422 serial port communications parameters (Baud Rate/Parity/Stop Bits).
Format	CBnnn
Range	nnn = baud rate, parity, stop bits (see description)
Default	CB411



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

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

Table 22: Serial Port Control

Baud Rate	Parity	Stop Bits
0 = 300		
1 = 1200	1 = None (Default)	1 = 1 Bit (Default)
2 = 2400	2 = Even	2 = 2 Bits
3 = 4800	3 = Odd	
4 = 9600 (Default)	4 = Low (Space, logical 0)	
5 = 19200	5 = High (Mark, logical 1)	
6 = 38400		
7 = 57600		
8 = 115200		

Setting the Baud Rate in the H-ADCP. The H-ADCP can be set to communicate at baud rates from 300 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 H-ADCP. This procedure assumes that you will be using the program *BBTalk* that is supplied by Teledyne RD Instruments.

- Connect the H-ADCP to the computer and apply power (see Figure 3).
- Start the *BBTalk* program and establish communications with the H-ADCP. Wakeup the H-ADCP by sending a break signal with the **End** key.
- Send the command CR1 to place the H-ADCP in the factory default setup.
- 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 23: Baud Rate

BAUD RATE	CB-command
300	CB011
1200	CB111
2400	CB211
4800	CB311
9600	CB411 (Default)
19200	CB511
38400	CB611
57600	CB711
115200	CB811

- BBTalk* will automatically change the settings to match your CB command settings and then *BBTalk* will send the CK command to save the new baud rate setting.
- Click **File, Close** to exit the terminal window.

The H-ADCP is now set for the new baud rate. The baud rate will stay at this setting until you change it back with the CB-command.



NOTE. If you send a BREAK before changing the external device's communication parameters, the H-ADCP returns to the communication parameters stored in non-volatile memory (user settings).

CF - Flow Control

Purpose	Sets various H-ADCP data flow-control parameters.
Format	CFnnnnnn
Range	Firmware switches (see description)
Default	CF11110



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

Description The CF-command defines whether the H-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; sends or does not send data to the recorder (if installed).

Table 24: 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 <input type="checkbox"/> character to signal ready to ping, and then waits to receive an <Enter> before pinging. The <Enter> sent to the H-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).
CFxx1x	Enable Serial Output – Sends the data ensemble out the RS-232/422 serial interface.
CFxx0x	Disable Serial Output – No ensemble data are sent out the RS-232/422 interface.
CFxxx1	Enable Data Recorder – Records data ensembles on the recorder (if installed).
CFxxx0	Disable Data Recorder – No data ensembles are recorded on the recorder.
Example	CF01010 selects manual ensemble cycling, automatic ping cycling, Hex-ASCII data output, enables serial output, and disables data recording.

CK - Keep Parameters

Purpose	Stores present parameters to non-volatile memory.
Format	CK



Recommended Setting. Use as needed.

Description CK saves the present user command parameters to non-volatile memory on the CPU board. The H-ADCP maintains data stored in the non-volatile memory (user settings) even if power is lost. It does not need a battery. You can recall parameters stored in non-volatile memory with the CR0-command (see [CR – Retrieve Parameters](#)).



NOTE. Always use the CK command in your configuration file (see [Using Direct Commands to Deploy your H-ADCP](#)).

The H-ADCP automatically stores the last set of commands used in RAM (volatile memory). The user can store the configuration into non-volatile memory by sending a CK command. Note that the H-ADCP will restart in the previous configuration even if it was not saved with a CK command as long as the volatile memory's internal battery is not discharged. This can happen after several months without any power applied to the H-ADCP (Note that this battery will recharge as soon as power is reapplied). If the H-ADCP is stopped by removing the power while pinging, it will restart pinging and output data next time power is applied.

CL - Battery Saver Mode

Purpose Determines whether the H-ADCP will attempt to conserve power by sleeping between pings.



NOTE. The CL command is only available for Rio Grande and H-ADCPs with 16.21 or higher firmware.

Format CL n
Range $n = 0$ to 1 (Sleep Between Pings (0 = No, 1 = Yes))
Default CL1



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

Description CL0 means the H-ADCP will not make any attempt to conserve power. Setting the CL command to CL1 means the H-ADCP will attempt to conserve power by going to sleep at every opportunity.



NOTE. In order for software breaks to work, the CL-command must be set to CL0 (see [Break](#)).

CM - Master

Purpose Deprecated.

CN - Save NVRAM to Recorder

Purpose: Saves the contents of NVRAM to the recorder at the end of a deployment.

Format CN n

Range $n = 0$ (On), 1 (Off)

Default CN1



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

Description The CN command allows the contents of the NVRAM (approx. 8k bytes) to be written to the recorder as part of the deployment record. This can be useful for troubleshooting purposes.

CP – Polled Mode

Purpose: Allows the H-ADCP to be polled for data.

Format CP n

Range $n = 0$ (Off), 1 (On)

Default CP0



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

Description The CP command allows an H-ADCP to be polled for data. Setting the CP command to CP1 places the H-ADCP into a mode where it doesn't sleep. Instead, the H-ADCP stays awake between pings listening for certain commands (and drawing more power). Polled mode is only recommended for deployments where shore power can be provided. The commands the H-ADCP responds to while in polled mode are shown in Table 25.

The polled mode requires sufficient time between pings to listen for the polling commands. Setting the TP command to 1 second normally gives the H-ADCP enough time for polling (see [TP – Time Between Pings](#)).



CAUTION. In the polled mode (CP1), enough time must be allowed in the ensemble cycle (TE or TP commands) to allow the system to check for serial input. If both TE and TP are set to zero for the maximum ping rate, the system will not recognize any keyboard input with the exception of a <break>.

The output of the polled mode is on demand. If the H-ADCP is in the middle of an ensemble when the command arrives, it will send out the last completed ensemble, even as it continues to collect data for the current ensemble. Note that the polled mode does not output data until at least one ensemble has been completed.

Table 25: Polled Mode Commands

Command	Description
!	Execute a Break reset
+	Increment internal clock by 1 second
-	Decrement internal clock by 1 second
D	Dump the last ensemble
E	Print the current ensemble number
T	Print the current time

The commands are not echoed and they don't need to be followed by a CR/LF pair. These commands are only available when CP = 1.



CAUTION. Enabling polled mode disables the battery saver feature. Do not enable this mode when running from batteries.

CQ – Transmit Power

Purpose	Allows the transmit power to be adjusted.
Format	CQnnn
Range	nnn = 0, or 1 to 255 (0 = Low, 1 to 255 = High)
Default	CQ255



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

Description	Allows the transmit power to be set high or low. This only affects 75 and 150 kHz systems.
-------------	--

CR – Retrieve Parameters

Purpose	Resets the H-ADCP command set to factory settings.
Format	CRn
Range	n = 0 (User), 1 (Factory)



Recommended Setting. Use as needed.

Description The H-ADCP automatically stores the last set of commands used in RAM. The H-ADCP will continue to be configured from RAM unless it receives a CR-command or until the RAM loses its power.

Table 26: Retrieve Parameters

Format	Description
CR0	Loads into RAM the command set last stored in non-volatile memory (user settings) using the CK-Command.
CR1	Loads into RAM the factory default command set stored in ROM (factory settings).



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

CS – Start Pinging (Go)

Purpose Starts the data collection cycle (same as the Tab key).

Format CS



Recommended Setting. Use as needed. Use *WinSC/VmDas/WinRiver* to create the command file. The CS command will be added to the end of the command file or sent by the software.

Description Use CS (or the Tab key) to tell the H-ADCP to start pinging its transducers and collecting data as programmed by the other commands. If the TF-command is set (time of first ping), the H-ADCP waits until it reaches the TF time before beginning the data collection cycle.



NOTES.

1. After a CS-command is sent to the H-ADCP, no changes to the commands can occur until a <BREAK> is sent.
2. If you try to record data (CFxxxx1), and the recorder is full, the H-ADCP will *not* start pinging and will return a *RECORDER NOT READY* message.

CY - Clear Error Status Word

Purpose Clears the Error Status Word (ESW) stored in EEPROM on the CPU. The ESW is updated whenever an error occurs.

Format CY n

Range $n = 0$ (Clear), 1 (Display)

Format Use the CY1 command to display the ESW value or CY0 to clear the ESW.



Recommended Setting. Use as needed.

Description CY1 displays the active ESW value, which is a 32-bit value displayed in Hex ASCII.

Table 27: Error Status Word

ESW	Description
0x00000001	Bus Error Exception occurred.
0x00000002	Address Error Exception occurred.
0x00000004	Illegal Inst Exception occurred.
0x00000008	Zero Divide Exception occurred.
0x00000010	Emulator Exception occurred.
0x00000020	Unassigned Exception occurred.
0x00000040	Watchdog restart occurred.
0x00000080	Screen Save power down occurred.
0x00000100	Currently pinging.
0x00000200	Unused
0x00000400	Unused
0x00000800	Unused
0x00001000	Unused
0x00002000	Unused
0x00004000	Cold wakeup occurred.
0x00008000	Unknown wakeup occurred.
0x00010000	Clock read failure occurred.
0x00020000	Unexpected Alarm.
0x00040000	Clock jump forward.
0x00080000	Clock jump backward.
0x00100000	Unused
0x00200000	Unused
0x00400000	Unused
0x00800000	Unused
0x01000000	Unused
0x02000000	Unused
0x04000000	Unused
0x08000000	Power Fail (Unrecorded)
0x10000000	Spurious level 4 interrupt (DSP).
0x20000000	Spurious level 5 interrupt (UART).
0x40000000	Spurious level 6 interrupt (CLOCK).
0x80000000	Level 7 interrupt occurred.

In the command mode, the Error Status Word (ESW) codes can be cleared through the CY-command. In ping mode, the ESW is cleared (set to zero) between each ensemble. The values are logically OR'ed. For example, if an illegal instruction (xxx4) and a divide by zero error (xxx8) occurred since the last time the ESW was cleared, a value of "xxxC" would appear as the ESW.



NOTE. ESW code 0x0000100 can only be seen if the CY-command is issued between CS-commands in the manual ping mode. This flag is used to determine if on wakeup, whether the H-ADCP was pinging or not previous to the present power up. A CS-command sets this bit; a <BREAK> resets the bit. This results in the following consequences:

- a) A deployment must be ended with a <BREAK>. If the H-ADCP is pinging, and power is lost, when power is restored, the H-ADCP will continue to ping.
- b) If the H-ADCP is in the command mode when power is lost, when power is restored, it will wakeup in the command mode. If a timeout occurs, the H-ADCP will power down automatically.



NOTE. In ping mode, the ESW is cleared (set to zero) between each ensemble. The ESW is written to the ensemble (see [Variable Leader Data Format](#)).

CZ – Power Down H-ADCP

Purpose Tells the H-ADCP to power down.

Format CZ



Recommended Setting. Use as needed.

Description Sending the CZ-command powers down the H-ADCP. H-ADCP processing is interrupted and the H-ADCP goes in the STANDBY mode (RAM is maintained).

Example See below

>CZ

Powering Down



NOTES.

1. When powered down using the CZ-command, the H-ADCP still draws up to 30µa, but wakes up periodically (every 8 to 12 hours) for a few seconds to maintain RAM.
2. This command should be used whenever batteries have been installed and you do not send commands to start a deployment. If you do not use the CZ-command, the H-ADCP will draw up to 50 milli-amps of current. *A new battery will be discharged in a few days.*
3. Performance and testing commands (i.e. AF, PA, PT, RB, and RY) override the battery saver functions. For example, using the RY-command to recover data from the H-ADCP while on battery power will disable the automatic power saver mode. If a CZ-command is not used after all data has been recovered, the H-ADCP will remain in the command mode. TRDI recommends disconnecting the batteries and using the AC power adapter while testing or recovering data.

10.4 Environmental Commands

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

10.4.1 Available Environmental Commands

This section lists the available Environmental commands.

```
>e?
EA = +00000 ----- Heading Alignment (1/100 deg)
EB = +00000 ----- Heading Bias (1/100 deg)
EC = 1500 ----- Speed Of Sound (m/s)
ED = 00000 ----- Transducer Depth (0 - 65535 dm)
EH = 00000 ----- Heading (1/100 deg)
EP = +0000 ----- Tilt 1 Sensor (1/100 deg)
ER = +0000 ----- Tilt 2 Sensor (1/100 deg)
ES = 00 ----- Salinity (0-40 pp thousand)
ET = +2500 ----- Temperature (1/100 deg Celsius)
EX = 11111 ----- Coord Transform (Xform:Type; Tilts; 3Bm; Map)
EZ = 1111101 ----- Sensor Source (C;D;H;P;R;S;T)
>
```

10.4.2 Environmental Command Descriptions

EA - Heading Alignment

Purpose	Corrects for physical misalignment between Beam 3 and the heading reference.
Format	EA±nnnnn
Range	±nnnnn = -17999 to 18000 (-179.99 to 180.00 degrees)
Default	EA+00000



Recommended Setting. For systems that are stationary, EA is typically set to zero (default), since Beam 3 is used as the heading reference.

Description EA is a heading alignment angle (referenced to Beam 3) used as a new zero reference for heading output and for transformation to earth coordinates. Use the **EB**-command to correct for heading bias (e.g., magnetic declination).

Example The H-ADCP is mounted in place on a moving ship. Beam 3 has been rotated 45 clockwise (+45) from the ship's centerline. Use the EA command to tell the H-ADCP where beam 3 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:

$$EA = +45.00 \times 100 = +4500 = EA+4500$$

EB - Heading Bias

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

Format	EB±nnnnnn
Range	±nnnnnn = -17999 to 18000 (-179.99 to 180.00 degrees)
Default	EB+00000



Recommended Setting. Use EB to counteract the effects of magnetic declination at the deployment site. Set using WinH-ADCP.

Description	EB is the heading angle that counteracts the electrical bias or magnetic declination between the H-ADCP and the heading source. Use the <u>E</u> A-command to correct for physical heading misalignment between the H-ADCP and a vessel's centerline.
Examples	A bottom-mounted H-ADCP is receiving heading from its internal compass. A navigation map for the deployment area shows a declination of 10°10'W 1995 (9'E/year). This means the magnetic offset in the year 2001 at this location is $(- (10+10/60) + (9/60*6)) = -9.26666$ degrees. Set the EB command value to EB-926.

EC - Speed of Sound

Purpose	Sets the speed of sound value used for H-ADCP data processing.
Format	ECnnnnn
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 H-ADCP to scale velocity data, depth cell size, and range to the bottom. The H-ADCP assumes the speed of sound reading is taken at the transducer head. See the primer for information on speed of sound calculations.
-------------	--



NOTE. If the EZ Speed of Sound field = 1, the H-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 H-ADCP transducer depth.
Format	EDnnnnnn
Range	nnnnn = 0 to 65535 decimeters (meters x 10)

Default ED00000



Recommended Setting. Use the EZ-command.

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

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

EH - Heading

Purpose Sets the H-ADCP heading angle.

Format EHnnnnnn

Range nnnnn = 0 to 35999 (000.00 to 359.99 degrees)

Default EH00000



Recommended Setting. Use the EZ-command.

Description EH sets the H-ADCP heading angle of beam 3. When mounted on a stationary platform, the H-ADCP assumes beam 3 points north (0).

Example Convert heading values of 34 and 3.5 to EH-command values.

EH = $34.00 \times 100 = 3400 = \text{EH03400}$
 EH = $3.50 \times 100 = 350 = \text{EH00350}$



NOTE. If the *EZ Heading* field = one, the H-ADCP overrides the manually set EH value and uses heading from the transducer's internal sensor. If the sensor is not available, the H-ADCP uses the manual EH setting.

EP - Pitch (Tilt 1)

Purpose Sets the H-ADCP pitch (tilt 1) angle.

Format EP±nnnn

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

Default EP+0000



Recommended Setting. Use the EZ-command.

Description EP sets the H-ADCP pitch (tilt 1) angle.

Example Convert pitch values of +14 and -3.5 to EP-command values.

$EP = 14.00 \times 100 = 1400 = EP01400$ (+ is understood)

$EP = -3.50 \times 100 = -350 = EP-00350$



NOTE. If the EZ Pitch field = 1, the H-ADCP overrides the manually set EP value and uses pitch from the transducer's internal tilt sensor. If the sensor is not available, the H-ADCP uses the manual EP setting.

ER - Roll (Tilt 2)

Purpose Sets the H-ADCP roll (tilt 2) angle.

Format $ER\pm nnnn$

Range $\pm nnnn = -6000$ to 6000 (-60.00 to +60.00 degrees)

Default $ER+0000$



Recommended Setting. Use the EZ-command.

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

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

$ER = 14.00 \times 100 = 1400 = ER1400$ (+ is understood)

$ER = -3.50 \times 100 = -350 = ER-0350$



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

ES – Salinity

Purpose Sets the water's salinity value.

Format $ESnn$

Range $nn = 0$ to 40

Default $ES0$



Recommended Setting. Set using *WinH-ADCP*. The default setting for this command is recommended for most applications.

Description ES sets the water's salinity value. The H-ADCP uses ES in its speed of sound calculations. The H-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 to 4000 (-5.00 C to +40.00 C)
Default	ET2500



Recommended Setting. Use the EZ-command.

Description ET sets the temperature value of the water. The H-ADCP uses ET in its speed of sound calculations (see the primer). The H-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



NOTE. If the EZ Temperature field = one, the H-ADCP overrides the manually set ET value and uses temperature from the transducer's temperature sensor. If the sensor is not available, the H-ADCP uses the manual ET setting.

EX – Coordinate Transformation

Purpose	Sets the coordinate transformation processing flags.
Format	EXxxptb
Range	xx = Transformation p = Pitch and Roll t = 2 beam solutions b = Bin mapping (not used)
Default	EX11110



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

Description EX sets firmware switches that control the coordinate transformation processing for velocity and percent-good data.

Table 28: Coordinate Transformation Processing Flags

Setting	Description
EX00xxx	No transformation. Radial beam coordinates, I.E., 1, 2, 3, 4. Heading/Pitch/Roll not applied.
EX01xxx	Instrument coordinates. X, Y, Z vectors relative to the H-ADCP. Heading/Pitch/Roll not applied.
EX10xxx	Ship coordinates (Note 1) X, Y, Z vectors relative to the ship. Heading not applied. EA-command used, but not the EB-command. If Bit 3 of the EX-command is a 1, then Pitch/Roll applied.
EX11xxx	Earth coordinates (Note 1) East, North, Vertical vectors relative to Earth. Heading applied. EA and EB-commands used. If Bit 3 of the EX-command is a 1, then Pitch/Roll applied.
EXxx1xx	Use tilts (pitch and roll) in transformation (see Note 2)
EXxxx1x	Allows 2-beam solutions if one beam is below the correlation threshold set by WC

NOTES.



1. For ship and earth-coordinate transformations to work properly, you must set the Heading Alignment (EA) and Heading Bias (EB) correctly. You also must ensure that the tilt and heading sensors are active (EZ).
2. Setting EX bit 3 (Use Tilts) to 0 lets you collect tilt data without using it in the ship or earth-coordinate transformations.
3. Each H-ADCP uses its own beam calibration matrix to correct data for beam pointing errors (e.g., if the beams erroneously point toward 21 degrees instead of 20 degrees). Correction is applied when the data are converted from beam coordinates to earth coordinates. If you output beam-coordinate data, you will need to apply the beam corrections yourself if you want the best possible data or use the *VmDas* software.

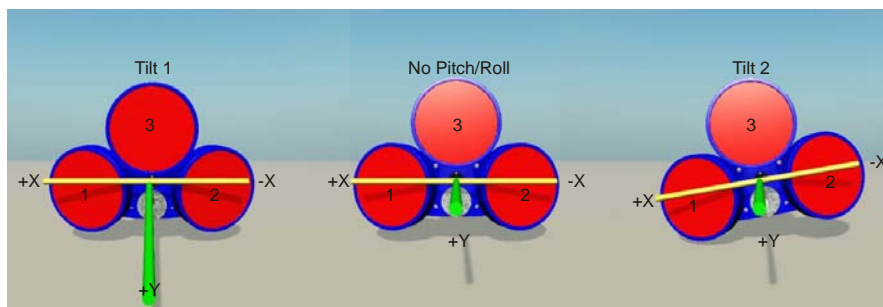


Figure 37. H-ADCP Coordinate Transformation

X – Axis - Pitch (Tilt 1) is measured around the X-axis.

Y- Axis - Roll (Tilt 2) is measured around the Y- axis.

EZ - Sensor Source

Purpose	Selects the source of environmental sensor data.
Format	EZcdhprst
Default	EZ1111101



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

Range	Firmware switches (see description)
Description	Setting the EZ-command firmware switches tells the H-ADCP to use data from a manual setting or from an associated sensor. When a switch value is non-zero, the H-ADCP overrides the manual E-command setting and uses data from the appropriate sensor. If no sensor is available, the H-ADCP defaults to the manual E-command setting. The following table shows how to interpret the sensor source switch settings.

Table 29: Sensor Source Switch Settings

Field	Value = 0	Value = 1
c Speed Of Sound	Manual EC	Calculate using ED, ES, and ET
d Depth	Manual ED	Depth Sensor
h Heading	Manual EH	Internal Transducer Sensor
p Pitch (Tilt 1)	Manual EP	Internal Transducer Sensor
r Roll (Tilt 2)	Manual ER	Internal Transducer Sensor
s Salinity	Manual ES	N/A
t Temperature	Manual ET	Internal Transducer Sensor

Example	EZ1111101 means calculate speed of sound from readings, use pressure sensor, transducer heading, internal tilt sensors, and transducer temperature.
---------	---

10.5 Fault Log Commands

The H-ADCP uses the following commands to aid in troubleshooting and testing.

10.5.1 Available Fault Log Commands

This section lists the most often used Fault Log commands.

```
>f?
Available Commands:

FC ----- Clear Fault Log
FD ----- Display Fault Log
FX ----- Toggle the Fault Log debug flag
F? ----- Display Fault Log Commands

>
```

10.5.2 Fault Log Command Descriptions

FC – Clear Fault Log

Purpose Clears the fault log.

Format FC



Recommended Setting. Use as needed.

Description Use this command to clear the fault log of all previous entries.

FD – Display Fault Log

Purpose Displays the fault log.

Format FD



Recommended Setting. Use as needed.

Description Displaying the fault log will list why a built-in test failed.
This may aid in troubleshooting.

Example >FD

```
Total Unique Faults   =      2
Overflow Count        =      0
Time of first fault:   97/11/05,11:01:57.70
Time of last fault:    97/11/05,11:01:57.70
```

Fault Log:

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

10.6 Performance and Testing Commands

The H-ADCP uses the following commands for calibration and testing.

10.6.1 Available Performance and Testing Commands

This section lists the available Performance and Testing commands.

```
>p?
PA ----- Pre-Deployment Tests
PC ### ----- Built In Tests, PC 0 = Help
PD = 00 ----- Data Stream Select (0-6,8,14)
PM ----- Distance Measure Facility
PS # ----- Show Sys Params (0=Xdcr,1=FLdr,2=VLdr,3=Mat,4=Seq)
PT ### ----- Built In Tests, PT 0 = Help
>
```

10.6.2 Performance and Testing Command Descriptions

PA – Pre-deployment Tests

Purpose	Sends/displays results of a series of H-ADCP system diagnostic tests.
Format	PA



Recommended Setting. Use as needed.

Description These diagnostic tests check the major H-ADCP modules and signal paths. We recommend you run this command before a deployment. These tests check the following boards/paths.

- CPU - CPU RAM and real-time clock.
- Recorder - verifies recorder operation.
- DSP - RAM, registers, and DSP-to-CPU Communications.
- System Tests - A test signal is routed through the DSP and back to the CPU. This checks the main electronics processor path.
- Receive Path - quiescent RSSI levels are checked for [20 < RSSI < 60 counts] and the RSSI filters are checked for proper time constants.
- Transmit Path - checks transmit voltage, current, and impedance.
- Sensors - verifies sensor operation.

Example see below

```
>PA
PRE-DEPLOYMENT TESTS
CPU TESTS:
  RTC.....PASS
  RAM.....PASS
  ROM.....PASS
RECORDER TESTS:
  PC Card #0.....DETECTED
  Card Detect.....PASS
```

```

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

```



NOTE. Wide Bandwidth and Narrow Bandwidth may fail if transducer is not in water. H/W Operation test will fail if the transducer is on its side.

PC – User-Interactive Built-In Tests

Purpose	Sends/displays results of user-interactive H-ADCP system diagnostic tests.
Format	PC nnn
Range	$nnn = 0$ to 2 (PC0 = Help menu; see below for others)



Recommended Setting. Use as needed.

Description	These diagnostic tests check beam continuity and sensor data. Both tests require user interaction (see examples).
Examples	See below.

PC0 – Help Menu

Sending PC0 displays the help menu.

```

User Interactive, Built In Tests
-----
PC0 = Help
PC1 = Beam Continuity
PC2 = Sensor Data

```

PC1 – Beam Continuity

Sending PC1 tests the beam continuity by measuring the quiescent Receiver Signal Strength Indicator (RSSI) levels. There must be a change of more than 30 counts when the transducer face is rubbed.

BEAM CONTINUITY TEST
 When prompted to do so, vigorously rub the selected beam's face.
 If a beam does not PASS the test, send any character to the H-ADCP to automatically select the next beam.

Collecting Statistical Data...

52 48 50 43
 Rub Beam 1 = PASS
 Rub Beam 2 = PASS
 Rub Beam 3 = PASS
 Rub Beam 4 = PASS

PC2 – Display Heading, Pitch, Roll, and Orientation

Sending PC2 displays heading, pitch angle, roll angle, up/down orientation and attitude temperature in a repeating loop at approximately 0.5-sec update rate. Press any key to exit this command and return to the command prompt.

Press any key to quit sensor display ...

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



NOTE. The PC2 heading shows the raw (magnetic north) heading only. The EB command (Heading Bias) is **not** applied.

PD - Data Stream Select

Purpose: Selects the type of ensemble output data structure.

Format: PDn

Range n = 0 to 18 (see description)

Default PD0



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

Description: PD selects the normal output data structure, a special application data structure, or a fixed data set for transmission/display as the data ensemble (see Table 30).

Table 30: Data Stream Selections

Format	Description
PD0	Sends The real water-current data set
PD1	Sends a TRDI-defined data set that always uses the same data (except for parts of the leader data). This data set is useful during user-software development.
PD2	Not used.
PD3	Sends Paramax-DVL ensemble output data structure.
PD4	Sends CSS-DVL output data structure (without sensor and made-good data).
PD5	Sends CSS-DVL output data structure (with sensor and made-good data).
PD6	Sends a special DVL ASCII data stream
PD7	Not used
PD8	Sends ensemble data as formatted ASCII text. A new-line character terminates each line. Two new-line characters terminate an ensemble.
PD14	Send the H-ADCP Condensed 2D Output Format
PD16	NMEA format without the leading '\$'
PD18	PD18 is the same Output Data Format as PD16, but with the leading '\$' necessary to fully comply with the NMEA format.



NOTE. All of TRDI's software supports PD0 formatted data only.

PM - Distance Measurement Facility

Purpose Lets you measure distance over the bottom.
 Format PM



Recommended Setting. For TRDI use only.

Description PM lets you use the H-ADCP to measure distances over the bottom using a dumb terminal.

PS – Display System Parameters

Purpose Sends/displays H-ADCP system configuration data.
 Format PS n
 Range $n = 0, 3$ (see description)



Recommended Setting. Use as needed.

Description See below.

PS0 – System Configuration

PS0 sends the H-ADCP hardware/firmware information. For example, the output may look like this:

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

Temp Sens Offset: -0.20 degrees C

CPU Firmware: 16.xx
Boot Code Ver: Required: 1.13 Actual: 1.13
DEMOM #1 Ver: ad48, Type: 1f
DEMOM #2 Ver: ad48, Type: 1f
PWRTIME Ver: 85d3, Type: 6
Board Serial Number Data:
08 00 00 02 C9 20 A7 09 CPU727-2000-00H
4D 00 00 00 D4 97 37 09 PIO727-3000-03C
>
```

PS3 – Instrument Transformation Matrix

PS3 sends information about the transducer beams. The H-ADCP uses this information in its coordinate-transformation calculations; for example, the output may look like this:

```
ps3
Beam Width: 3.7 degrees

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

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

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

If the H-ADCP needs beam angle corrections, a TRDI calibrated beam angle matrix is loaded into the instrument. This is done when the instrument is manufactured. For more details, request a copy of the H-ADCP Coordinate Transformation booklet (available for download at www.rdinstruments.com).

The output may look like this for an H-ADCP.

Beam Width: 3.7 degrees

```
Instrument Transformation Matrix (Down):      Q14:
-1.1831   1.1831   0.0000   0.0000      -19384   19384       0       0
-0.3430  -0.3430  -0.3784   0.0000      -5619  -5619    -6199    0
 0.0000   0.0000   0.0000   0.0000       0       0       0       0
 0.7278   0.7278  -1.3192   0.0000      11924  11924   -21613    0
Beam Angle Corrections Are Loaded.
>
```

The error velocity for an H-ADCP is equal to the difference between the Y velocities of beams one and two and the Y velocity of beam three (Error = $V1 * E1 + V2 * E2 + V3 * E3$).

PT - Built-In Tests

Purpose Sends/displays results of H-ADCP system diagnostic test.

Format PTnnn

Range nnn = 0 to 200 (PT0 = Help menu)



Recommended Setting. Use as needed.

Description These diagnostic tests check the major H-ADCP modules and signal paths. Most of the tests give their final results in the format;

```
xxxxxxxxxx TEST RESULTS = $hhhh ... rrrr
```

Where

xxxxxxxxxx = Module or path being tested

\$hhhh = Hexadecimal result code (\$0 = PASS; see individual tests for description of bit results)

rrrr = Overall test result ("PASS" or "FAIL")

PT Test Results Error Codes

To find what bits are set when an error occurs, use the following tables.

Table 31: Error Code Hex to Binary Conversion

Hex Digit	Binary	Hex Digit	Binary
0	0000	8	1000
1	0001	9	1001
2	0010	A	1010
3	0011	B	1011
4	0100	C	1100
5	0101	D	1101
6	0110	E	1110
7	0111	F	1111

To convert error code \$32CF (note: the dollar sign "\$" signifies hexadecimal), convert 32CF to binary. Error code \$32CF has the following bits set: 13, 12, 9, 7, 6, 3, 2, 1, 0.

Hex Digit \$	3				2				C				F			
Binary	0	0	1	1	0	0	1	0	1	1	0	0	1	1	1	1
Bit #	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

PT0 - Help

Displays the test menu (shown below). As implied by the NOTE, adding 100 to the test number repeats the test continually until the H-ADCP receives a <BREAK>. Sending PT200 runs all tests. PT300 runs all tests continually until the H-ADCP receives a <BREAK>.

```
>PT0
Built In Tests
-----
PT0 = Help
PT1 = NA
PT2 = Ancillary System Data
PT3 = Receive Path
PT4 = Transmit Path
PT5 = Electronics Wrap Around
PT6 = Receive Bandwidth
PT7 = RSSI Bandwidth
NOTE: Add 100 for automatic test repeat
PT200 = All tests
```

PT2 - Ancillary System Data

This test displays the values for ambient and attitude temperature and the contamination sensor (TRDI use only). The ambient temperature is measured on the receiver board. This sensor is imbedded in the transducer head, and is used for water temperature reading. The attitude temperature is measured on the PIO board under the compass. If one of the sensors fails, the PC2 test will show both sensors at the same value. The H-ADCP will use the attitude temperature if the ambient temperature sensor fails. A reading $\geq +55^{\circ}$ may indicate a shorted sensor, and a reading $\geq -32^{\circ}$ may indicate an open sensor.

```
>PT2
Ambient Temperature = 21.10 Degrees C
Attitude Temperature = 21.39 Degrees C
Internal Moisture = 8D50h
```

PT3 - Receive Path

This test displays receive path characteristics. The test result is given as eight nibbles (1 nibble = 4 bits). Each nibble represents the result for a particular beam (most significant nibble = beam 1, least significant nibble = beam 8) (four beam H-ADCPs utilize the four most significant nibbles). In this example, we only describe which bit is set for beam 2 for a given failure type. This test has three parts.

Part 1 - The H-ADCP pings without transmitting and displays the result of an autocorrelation function performed over 14 lag periods (only the first 8

are displayed). Ideally, we should see high correlation at near-zero lags, and then see decorrelation as the lags get longer. High correlation values at longer lags indicate interference is present.

Part 2 - The H-ADCP compares the RSSI value at high gain versus low gain. These values give the noise floor for RSSI. A high noise floor indicates possible interference or a hardware problem. A low difference between high and low RSSI values can indicate a problem in the demodulator, receiver, or RSSI switching circuitry.

Part 3 - The H-ADCP displays the demodulator DAC values.

>PT3

Correlation Magnitude: Wide Bandwidth

Lag	Bm1	Bm2	Bm3	Bm4
0	255	255	255	255
1	169	175	167	179
2	49	55	54	58
3	26	20	19	8
4	20	17	24	29
5	14	13	14	23
6	8	4	13	8
7	6	1	10	1

High Gain RSSI: 43 41 40 42
Low Gain RSSI: 19 19 17 18

SIN Duty Cycle: 52 50 52 51
COS Duty Cycle: 49 50 51 51

Receive Test Results = \$0000 PASS

PT3 failure description - You can determine beam failure results (\$>0, see [PT Test Results Error Codes](#)) by the individual bit settings:

Table 32: PT3 Failure

Bit #	PT3 Failure Description
0	Low Correlation – Correlation at lag 1 is <70% (130 counts).
1	High Correlation - A correlation at lag 7 or above is >63 counts.
2	High Noise Floor - Noise floor for high gain is >59.
3	Low Differential Gain – Noise floor difference between high and low gains is less than 5 dB (10 counts).



NOTE. A functional H-ADCP may fail high correlation or high noise floor when this test is run in air due to interference. This test should be run in the deployed environment to achieve good results.

PT4 - Transmit Path

This test displays transmit path characteristics. During the test, the H-ADCP pings and measures the resulting transmit current and voltage. For example:

```
>PT4
IXMT    =      2.0 Amps rms
VXMT    =      74.0 Volts rms
Z       =      37.6 Ohms
Transmit Test Results = $0 ... PASS
```



NOTE. The H-ADCP should be in water during this test to get valid test results.

PT4 failure description - You can determine failure results (\$>0 see [PT Test Results Error Codes](#)) by the individual bit settings:

Table 33: PT4 Failure

Bit #	PT4 Failure Description
0	ADC TIMEOUT ERROR - The DSP Board ADC was not ready for reading when the CPU was ready to read the ADC.
1	TRANSMIT TIMEOUT - The DSP Board never indicated completion of transmission.
2	SAMPLE TIMEOUT - The DSP Board never indicated completion of sampling.
3	LCA REGISTERS CORRUPTED - The DSP Board timing registers lost their value after ping-ing.
4	OVER-CURRENT SHUTDOWN
5	OVER-TEMPERATURE SHUTDOWN
6	INCORRECT TRANSDUCER IMPEDANCE - Impedance (Vxmt / Ixmt) was too high (>200Ω) or too low (<20Ω).
7	LOW TRANSMIT VOLTS AND/OR CURRENT - Transmit voltage was too low (Vxmt <10V) and/or transmit current too low (Ixmt <0.1A).



NOTE. The transducer should be in water when running this test.

The test failure example shown below is what you would see for a missing or improperly attached transmit cable (see [Troubleshooting a Built-In Test Failure](#)).

```
>pt4
IXMT    =      0.0 Amps rms [Data= 0h]
VXMT    =      19.3 Volts rms [Data=4ch]
Z       =      999.9 Ohms
Transmit Test Results = $C0 ... FAIL
>
```

PT5 - Electronics Wrap Around

This test sets up the H-ADCP in a test configuration in which the test output lines from the DSP Board timing generator are routed directly to the Receiver board. The receiver then processes this signal. The test output signal sends a certain correlation pattern when processed. The ideal pattern is as follows.

```
0 0 0 0
0 0 0 0
0 0 0 0
0 0 0 0
255 255 255 255
0 0 0 0
0 0 0 0
255 255 255 255
0 0 0 0
0 0 0 0
0 0 0 0
255 255 255 255
```

Acceptable deviations from this pattern are due to deviations in sampling bandwidth and demodulator low-pass filter bandwidth variations. For example:

```
>PT5
13 13 13 13
13 13 13 13
13 13 13 13
0 0 0 0
255 255 255 255
13 13 13 13
0 0 0 0
255 255 255 255
13 13 13 13
13 13 13 13
0 0 0 0
255 255 255 255
Electronics Test Results = $0000
```

PT5 results description - Test failures indicate possible problems with the Receiver or DSP boards. You can determine failure results (\$>0 see [PT Test Results Error Codes](#)) by the individual bit settings:

Table 34: PT5 Results

Bit #	PT5 Results Description
28	BEAM 1 STATUS - A high value (normally 255) was <254, or a low value (normally 0) was >20.
24	BEAM 2 STATUS - See Bit 28.
20	BEAM 3 STATUS - See Bit 28.
16	BEAM 4 STATUS - See Bit 28.
12	BEAM 5 STATUS - See Bit 28.
ALL	RECEIVER TIMEOUT – The CPU never received a “processing done” signal from the receiver.

PT6 - Receive Bandwidth

This test measure the receive bandwidth of the system. The bandwidth varies with system frequency and the WB command setting.

```
>PT6
Receive Bandwidth:
  Sample    bw    bw    bw    bw    bw
  rate  expect Bm1  Bm2  Bm3  Bm4
    307    120   91   93   88   88 Khz
  results          PASS  PASS  PASS  PASS
```



NOTE. The H-ADCP should be in water during this test to get valid test results.

Table 35: PT6 Receive Bandwidth Nominal Values

Bandwidth setting	WB command	300 kHz	600 kHz
Broad	0	79	200
Narrow	1	14	40



NOTE. Beam fails if <50% or >125% of nominal value.

PT7 - RSSI Bandwidth

This test checks the RSSI filter circuits are working. Values listed are the indicated RSSI sampled at 1-ms intervals after a “listen” ping.

```
>PT7
RSSI Time Constant:

RSSI Filter Strobe 1 = 38400 Hz
  time    Bm1    Bm2    Bm3    Bm4
  msec  cnts  cnts  cnts  cnts
    1      6      6      7      8
    2     11     12     14     15
    3     15     16     19     20
    4     20     21     23     25
    5     23     24     27     28
    6     26     27     30     31
    7     28     29     32     33
    8     30     31     34     35
    9     32     33     36     37
   10     34     35     37     38
  nom     43     43     42     43

result    PASS  PASS  PASS  PASS
>
```

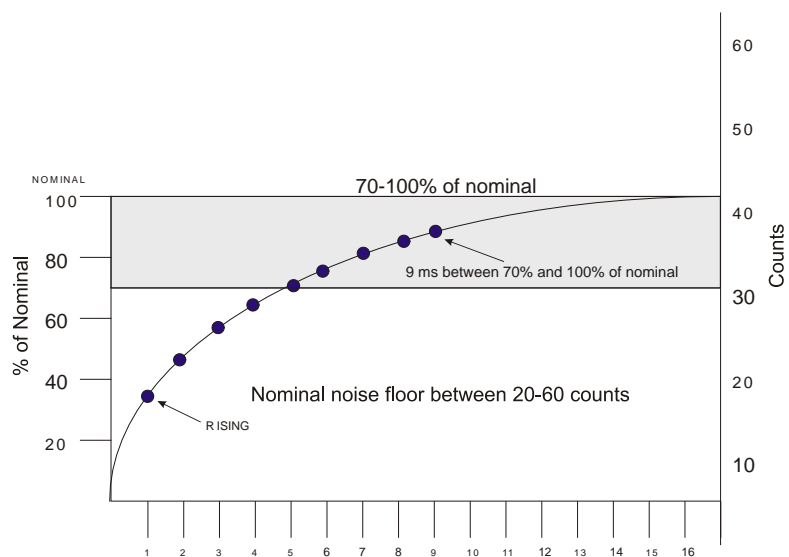


Figure 38. PT7 RSSI Bandwidth Test

Criteria for failure. Any one of the following conditions will flag failure for the beam:

Nominal noise floor <20 or >60

Counts for ms 1 through 4 not rising

9th ms sample not between 70 and 100% of nominal counts

10.7 Recorder Commands

The following paragraphs list all the H-ADCP recorder commands.

10.7.1 Available Recorder Commands

This section lists the available Recorder commands.

```
>r?
Available Commands:

RA ----- Number of Deployments Recorded
RB ----- Recorder Built-In-Test
RE ----- Recorder Erase
RF ----- Recorder Space used/free (bytes)
RN g , ----- Set Deployment Name
RR ----- Recorder diRectory
RS ----- Recorder Space used/free (Mb)
RY ----- Upload Recorder Files to Host
R? ----- Display Recorder Commands

>
```

RA - Number of Deployments

Purpose Shows the number of deployments recorded on the internal recorder.

Format RA



Recommended Setting. Use as needed.

Description RA lists the number of deployments recorded on the optional internal recorder.

RB - Recorder Built-In Test

Purpose Tests the recorder.

Format RB



Recommended Setting. Use as needed. The recorder test is included in the PA command.

Description RB tests the recorder RAM, detects the number of memory cards, checks communication, and checks recorder functions using non-destructive methods.

Example See below.

```
>rb?
RECORDER TESTS:
PC Card #0.....NOT DETECTED
PC Card #1.....DETECTED
Card Detect.....PASS
Communication.....PASS
DOS Structure.....PASS
Sector Test (Short).....PASS
```

Recorder tests complete.

RE – Erase Recorder

Purpose	Erases/initializes recorder memory.
Format	RE ErAsE
Description	RE ErAsE erases the recorder memory. This command <i>is</i> case sensitive.



Recommended Setting. Use as needed.

Example See below.

```
>RE ErAsE  
[ERASING...]
```

RF – Recorder Free Space (Bytes)

Purpose	Lists the amount of used and free recorder space in bytes.
Format	RF
Description	RF lists the amount of recorder space used and free in bytes.



Recommended Setting. Use as needed.

Example See below

```
>RF  
RF = 0,10407936 ----- REC SPACE USED (BYTES), FREE (BYTES)
```

This shows the H-ADCP contains a 10-MB recorder.

RN – Set Deployment Name

Purpose	Sets the deployment name used for future deployments.
Format	RN AAAAA
Default	RN _RDI_



Recommended Setting. Use as needed.

Description	RN sets the deployment name to be used for any future deployments. The deployment name must be exactly five characters in length, and may contain letters, numbers, or the underscore (i.e. “_”) character. If no deployment name is specified, a default of “_RDI_” is used. The deployment name is used as part of the DOS file name for data files stored on the recorder. For example, the file “_RDI_000.000” would contain data for
-------------	---

the first deployment named “_RDI_” (the 000 in the filename indicates the first deployment). The “.000” file extension indicates that this is the first file in the deployment sequence. A “.001” extension will be used if the deployment spills over onto the second PCMCIA card in the recorder. Each PCMCIA card is set up as a separate DOS disk drive with its own DOS file structure. Deployments that are recorded completely on a single PCMCIA device will only have the “.000” file extension.

RR – Show Recorder File Directory

Purpose	Lists the files on the recorder in the style of a DOS directory listing.
Format	RR



Recommended Setting. Use as needed.

Description	RR lists the files stored on the recorder in the form of a DOS directory listing. Each PCMCIA device is listed as a separate drive.
-------------	---

RS - Recorder Free Space (Megabytes)

Purpose	Lists the amount of used and free recorder space in megabytes.
Format	RS



Recommended Setting. Use as needed.

Description	RS lists the amount of recorder space used and free in megabytes.
-------------	---

Example	See below
---------	-----------

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

This shows the H-ADCP contains a 10-MB recorder.

RY – Upload Recorder Files

Purpose Uploads recorder data to a host computer using standard YMODEM protocol.

Format RY



Recommended Setting. Use as needed.

Description RY uploads the entire contents of the recorder via the serial interface to a host computer using the standard YMODEM protocol for binary file transfer. Any communications program that uses the YMODEM protocol may be used to upload the recorder data. The data is transferred to the host and stored as binary files. This command may be used to recover deployment data without opening the pressure case of the H-ADCP unit.

Alternatively, the PCMCIA recorder cards may be removed from the unit and placed into a PCMCIA slot in any MS-DOS based computer so equipped. The data files may then be accessed in the same manner as from any other disk drive.



CAUTION. Do not use Windows® to erase the files on the PCMCIA card. Windows® sometimes creates hidden files, which will cause issues for the H-ADCP at the next deployment. Place the PCMCIA card in the H-ADCP and use the RE command to erase the card.

10.8 Timing Commands

The following commands let you set the timing of various profiling functions.

10.8.1 Available Timing Commands

This section lists the available Timing commands.

```
>t?
TB = 00:00:00.00 ----- Time per Burst (hrs:min:sec.sec/100)
TC = 00000 ----- Ensembles Per Burst (0-65535)
TE = 00:00:00.00 ----- Time per Ensemble (hrs:min:sec.sec/100)
TF = **/**/**,***:***:*** --- Time of First Ping (yr/mon/day,hour:min:sec)
TG = ****/**/**,***:***:*** - Time of First Ping (CCYY/MM/DD,hh:mm:ss)
TP = 00:00.05 ----- Time per Ping (min:sec.sec/100)
TS = 07/08/20,11:20:36 --- Time Set (yr/mon/day,hour:min:sec)
TT = 2007/08/20,11:20:36 - Time Set (CCYY/MM/DD,hh:mm:ss)
>
```

10.8.2 Timing Command Descriptions

TB - Time per Burst

Purpose	Sets the interval between “bursts” of pings.
Format	TB hh:mm:ss.ff
Range	hh = 00 to 23 hours mm = 00 to 59 minutes ss = 00 to 59 seconds ff = 00 to 59 hundredths of seconds



Recommended Setting. Special applications only.

Description The TB and TC commands work together to allow the H-ADCP to sample in a “burst mode.” In some applications, it is desirable for the H-ADCP to ping for a short period of time at a high ping rate (“burst”), wait for a set period of time, and then repeat the process. You also must set the time per ensemble, time between pings, and number of pings per ensemble.

Example Deployment timing example:

```
TB 01:00:00.00 (time per burst)
TC 20 (ensembles per burst)
TE 00:00:01.00 (time per ensemble)
TP 00:00.20 (time between pings)
WP 2 (pings per ensemble)
```

The H-ADCP will average two pings (WP-command) 0.2 seconds apart (TP-command). It then sends the ensemble to the recorder or through the I/O cable. This process is repeated once a second (TE-command) for a total of twenty ensembles (TC-command). After the 20th ensemble is processed,

the H-ADCP sleeps for one hour (TB-command) from the time of the first ping of the first ensemble until the second burst begins.

TC - Ensemble per Burst

Purpose	Sets the number of ensembles per burst.
Format	TCnnnnn
Range	0 to 65535 ensembles per burst
Default	TC0



Recommended Setting. Special applications only.

Description Setting TC to zero disables the burst mode (i.e., TB-command inactive). See the TB-command for details on how these two commands interact.

TE – Time per Ensemble

Purpose	Sets the minimum interval between data collection cycles (data ensembles).
Format	TEhh:mm:ss.ff
Range	<i>hh</i> = 00 to 23 hours <i>mm</i> = 00 to 59 minutes <i>ss</i> = 00 to 59 seconds <i>ff</i> = 00 to 99 hundredths of seconds
Default	TE00:00:00.00



Recommended Setting. Set using *WinH-ADCP*.

Description During the ensemble interval set by TE, the H-ADCP transmits the number of pings set by the WP-command. If TE = 00:00:00.00, the H-ADCP starts collecting the next ensemble immediately after processing the previous ensemble.

Example TE01:15:30.00 tells the H-ADCP to collect data ensembles every 1 hour, 15 minutes, 30 seconds.



NOTES.

1. The H-ADCP automatically increases TE if $(WP \times TP > TE)$.
2. The time tag for each ensemble is the time of the first ping of that ensemble.

TF – Time of First Ping

Purpose	Sets the time the H-ADCP wakes up to start data collection.		
Format	TFyy/mm/dd, hh:mm:ss		
Range	yy	= year	00 to 99
	mm	= month	01 to 12
	dd	= day	01 to 31 (leap years are accounted for)
	hh	= hour	00 to 23
	mm	= minute	00 to 59
	ss	= second	00 to 59



Recommended Setting. Set using *WinH-ADCP*.

Description TF delays the start of data collection. This lets you deploy the H-ADCP in the Standby mode and have it automatically start data collection at a preset time (typically used in battery operated instruments). When the command is given to the H-ADCP to start ping, TF is tested for validity. If valid, the H-ADCP sets its alarm clock to TF, goes to sleep, and waits until time TF before beginning the data collection process.

Example If you want the exact time of the first ping to be on November 23, 1992 at 1:37:15 pm, you would enter TF92/11/23, 13:37:15. If you want the H-ADCP to begin pinging immediately after receiving the CS-command (see notes), do not enter a TF-command value.

NOTES.

1. Although you may send a TF-command to the H-ADCP, you also must send the CS-command before deploying the H-ADCP.
2. If the entry is not valid, the H-ADCP sends an error message and does not update the wake-up time.
3. Sending a <BREAK> clears the TF time.

TG – Time of First Ping (Y2k Compliant)

Purpose	Sets the time the H-ADCP wakes up to start data collection.		
Format	TGccyy/mm/dd, hh:mm:ss		
Range	cc	= century	19 to 20
	yy	= year	00 to 99
	mm	= month	01 to 12
	dd	= day	01 to 31 (leap years are accounted for)
	hh	= hour	00 to 23
	mm	= minute	00 to 59
	ss	= second	00 to 59



Recommended Setting. Set using *WinH-ADCP*.

Description TG delays the start of data collection. This lets you deploy the H-ADCP in the Standby mode and have it automatically start data collection at a preset time (typically used in battery operated instruments). When the command is given to the H-ADCP to start pinging, TG is tested for validity. If valid, the H-ADCP sets its alarm clock to TG, goes to sleep, and waits until time TG before beginning the data collection process.

Example If you want the exact time of the first ping to be on November 23, 2000 at 1:37:15 pm, you would enter TG 2000/11/23, 13:37:15. If you want the H-ADCP to begin pinging immediately after receiving the CS-command (see notes), do not enter a TG -command value.

NOTES.



1. Although you may send a TG -command to the H-ADCP, you also must send the CS-command before deploying the H-ADCP.
2. If the entry is not valid, the H-ADCP sends an error message and does not update the wake-up time.
3. Sending a <BREAK> clears the TG time.

TP – Time Between Pings

Purpose	Sets the <i>minimum</i> 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	TP00:01.00 (300 kHz), TP00:00.20 (600 kHz)



Recommended Setting. Set using *WinH-ADCP*.

Description The H-ADCP interleaves individual pings within a group so they are evenly spread throughout the ensemble.

During the ensemble interval set by TE, the H-ADCP transmits the number of pings set by the WP-command. TP determines the spacing between the pings. If TP = 0, the H-ADCP pings as quickly as it can based on the time it takes to transmit each ping plus the overhead that occurs for processing. Several commands determine the actual ping time (WF, WN, WS, and actual water depth).

Example TP00:00.10 sets the time between pings to 0.10 second.



NOTE. The H-ADCP automatically increases TE if $(WP \times TP) > TE$.

TS – Set Real-Time Clock

Purpose	Sets the H-ADCP's internal real-time clock.		
Format	TSyy/mm/dd, hh:mm:ss		
Range	yy	= year	00 to 99
	mm	= month	01 to 12
	dd	= day	01 to 31
	hh	= hour	00 to 23
	mm	= minute	00 to 59
	ss	= second	00 to 59



Recommended Setting. Set using *BBTalk* or *WinH-ADCP*.

Example TS98/06/17, 13:15:00 sets the real-time clock to 1:15:00 pm, June 17, 1998.

NOTES.



1. When the H-ADCP receives the carriage return after the TS-command, it enters the new time into the real-time clock and sets hundredths of seconds to zero.
2. If the entry is not valid, the H-ADCP sends an error message and does not update the real-time clock.

TT – Set Real-Time Clock (Y2k Compliant)

Purpose	Sets the H-ADCP's internal real-time clock.		
Format	TTccyy/mm/dd, hh:mm:ss		
Range	cc	= century	19 to 20
	yy	= year	00 to 99
	mm	= month	01 to 12
	dd	= day	01 to 31
	hh	= hour	00 to 23
	mm	= minute	00 to 59
	ss	= second	00 to 59



Recommended Setting. Set using *BBTalk* or *WinH-ADCP*.

Example TT2000/06/17, 13:15:00 sets the real-time clock to 1:15:00 pm, June 17, 2000.

NOTES.



1. When the H-ADCP receives the carriage return after the TS-command, it enters the new time into the real-time clock and sets hundredths of seconds to zero.
2. If the entry is not valid, the H-ADCP sends an error message and does not update the real-time clock.

10.9 Water Profiling Commands

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

10.9.1 Standard Water Profiling Commands

This section lists the most often used Water Profiling commands.

```
>w?
WA = 255 ----- False Target Threshold (Max) (0-255 counts)
WB = 1 ----- Bandwidth Control (0=Wide,1=Narrow)
WC = 064 ----- Correlation Threshold
WD = 111 100 000 ----- Data Out (Vel;Cor;Amp PG;St:P0 P1:P2:P3)
WE = 1500 ----- Error Velocity Threshold (0-5000 mm/s)
WF = 0050 ----- Blank After Transmit (cm)
WI = 0 ----- Clip Data Past Bottom (0=OFF,1=ON)
WJ = 1 ----- Rcvr Gain Select (0=Low,1=High)
WL = 000,005 ----- Water Reference Layer: Begin Cell (0=OFF), End Cell
WN = 030 ----- Number of depth cells (1-255)
WP = 00030 ----- Pings per Ensemble (0-16384)
WQ = 0 ----- Sample Ambient Sound (0=OFF,1=ON)
WS = 0200 ----- Depth Cell Size (cm)
WT = 0000 ----- Transmit Length (cm) [0 = Bin Length]
WU = 0 ----- Ping Weighting (0=Box,1=Triangle)
WV = 185 ----- Mode 1 Ambiguity Vel (cm/s radial)
WW = 004 ----- Mode 1 Pings before Mode 4 Re-acquire
WY = 1,185 ----- WM 1: Bandwidth (0=WB, 1=NB), Amb. Vel.(cm/s)
>
```

WA - False Target Threshold Maximum

Purpose	Sets a false target (fish) filter.
Format	WAnnn
Range	nnn = 0 to 255 counts (255 disables this filter)
Default	WA255



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

Description The H-ADCP uses the WA-command to screen water-track 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 H-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.



NOTE. A WA value of 255 turns off this feature.

WB - Mode 1 Bandwidth Control

Purpose	Sets profiling mode 1 bandwidth (sampling rate). Smaller bandwidths allow the H-ADCP to profile farther, but the standard deviation is increased by as much as 2.5 times.
Format	WB n
Range	$n = 0$ (Wide), 1 (Narrow)
Default	WB1



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

Description See table below.

Table 36: Bandwidth Control

Bandwidth	Sample rate	Data variance	Profiling range
0 = Wide (25%)	High	Low	Low
1 = Narrow (6.25%)	Low	High	High

WC - Low Correlation Threshold

Purpose	Sets the minimum threshold of water-track data that must meet the correlation criteria.
Format	WC nnn
Range	$nnn = 0$ to 255 counts
Default	WC64



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

Description The H-ADCP uses WC to screen water-track data for the minimum acceptable correlation requirements. The nominal (maximum) correlation depends on system frequency and depth cell size (WS). WC sets the threshold of the correlation below, which the H-ADCP flags the data as bad and does not average the data into the ensemble.



NOTE. The default threshold for all frequencies is 64 counts. A solid target would have a correlation of 255 counts.

WD – Data Out

Purpose	Selects the data types collected by the H-ADCP.
Format	WD <i>abc def ghi</i>
Range	Firmware switches (see description)
Default	WD 111 100 000



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

Description WD uses firmware switches to tell the H-ADCP the types of data to collect. The H-ADCP always collects header data, fixed and variable leader data, and checksum data. Setting a bit to one tells the H-ADCP to collect that data type. The bits are described as follows:

<i>a</i> = Velocity	<i>d</i> = Percent good	<i>g</i> = Reserved
<i>b</i> = Correlation	<i>e</i> = Status	<i>h</i> = Reserved
<i>c</i> = Echo Intensity	<i>f</i> = Reserved	<i>i</i> = Reserved

Example WD 111 100 000 (default) tells the H-ADCP to collect velocity, correlation magnitude, echo intensity, and percent-good.

NOTES.



1. Each bit can have a value of one or zero. Setting a bit to one means output data, zero means suppress data.
2. If WP = zero, the H-ADCP does not collect water-profile data.
3. Spaces in the command line are allowed.
4. Status data is not used, as it does not mean anything.

WE - Error Velocity Threshold

Purpose	Sets the maximum error velocity for good water-current data.
Format	WE <i>nnnn</i>
Range	<i>nnnn</i> = 0 to 9999 mm/s
Default	WE1500



CAUTION. 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.**

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

transformed-coordinate data. Setting the WE command to zero (WE0) disables error velocity screening.

WF – 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	WFnnnn
Range	nnnn = 0 to 9999 cm
Default	WF175 (300 kHz), WF100 (600 kHz)



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 H-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.
-------------	--



NOTES.

1. The distance to the middle of depth cell #1 is a function of blank after transmit (WF), depth cell size (WS), and speed of sound. The fixed leader data contains this distance.
2. Small WF values may show ringing/recovery problems in the first depth cells that cannot be screened by the H-ADCP.

WI - Clip Data Past Bottom

Purpose	Allows the H-ADCP to flag velocity data from beyond the bottom as bad.
Format	WI <i>n</i>
Range	<i>n</i> = 0 (Off), 1 (on)
Default	WI0



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

Description	When the WI-command is set to WI0 (default), the H-ADCP sends/records all velocity data readings even when the H-ADCP determines the data is beyond the bottom. WI1 tells the H-ADCP to flag data determined to be beyond the bottom as bad (data value set to -32768 [8000h]).
-------------	---

WJ - Receiver Gain Select

Purpose	Allows the H-ADCP to reduce receiver gain by 40 dB.
Format	WJ <i>n</i>
Range	<i>n</i> = 0 (Low), 1 (High)
Default	WJ1



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

Description	WJ0 tells the H-ADCP to reduce receiver gain by 40 dB. This may increase data reliability in shallow-water applications where there is a high content of backscatter material. WJ1 (the default) uses the normal receiver gain.
-------------	---

WL - Water Reference Layer

Purpose	Sets depth cell range for water-track reference layer averaging.
Format	WL <i>sss,eee</i>
Range	<i>sss</i> = Starting depth cell (0 to 128; 0 disables this feature) <i>eee</i> = Ending depth cell (1 to 128)
Default	WL0,5



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

Description	You can use the WL-command to lower the effects of transducer motion on present measurements for multiple-ping ensembles (WP > 1). The H-ADCP does this by averaging the velocities of a column of water and subtracting that average from each of the depth cell velocities. The H-ADCP accumulates the resulting average velocity and depth cell velocities. At the end on an ensemble, the H-ADCP adds the average reference velocity back to the normalized depth cell velocities. This results in quieter data for depth cells in which there were few good samples.
-------------	---

WN – Number of Depth Cells

Purpose	Sets the number of depth cells over which the H-ADCP collects data.
Format	WNnnn
Range	nnn = 1 to 255 depth cells
Default	WN30



Recommended Setting. Set using *WinH-ADCP*.

Description	The range of the H-ADCP is set by the number of depth cells (WN) times the size of each depth cell (WS).
-------------	--

WP – Pings Per Ensemble

Purpose	Sets the number of pings to average in each data ensemble.
Format	WPnnnnn
Range	nnnnn = 0 to 16384 pings
Default	WP30



Recommended Setting. Set using *WinH-ADCP*.

Description	WP sets the number of pings to average in each ensemble before sending/recording the data.
-------------	--



NOTES.

1. If WP = zero the H-ADCP does not collect water-profile data.
2. The H-ADCP automatically extends the ensemble interval (TE) if WP x TP > TE.

WQ - Sample Ambient Sound

Purpose	Samples ambient sound.
Format	WQn
Range	n = 0 (Off), 1 (On)
Default	WQ0



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

Description	When WQ is set to 1, the H-ADCP samples RSSI before the water ping. WQ uses an 8-meter blank and 8-meter depth cell before sending water-profiling pings.
-------------	---

WS – Depth Cell Size

Purpose	Selects the volume of water for one measurement cell.	
Format	WSnnnn	
Range	See below	
Default	See below	

	300kHz	600kHz
Range	20 to 1600 cm	10 to 800 cm
Default	WS800	WS400



Recommended Setting. Set using WinH-ADCP.

Description The H-ADCP collects data over a variable number of depth cells. WS sets the size of each cell in vertical centimeters.



NOTE. If you set WS to a value less than its minimum value or greater than its maximum value, the H-ADCP will accept the entry, but uses the appropriate minimum or maximum value. For example, if you enter WS0001 for a 300kHz system, the H-ADCP uses a value of 20 cm for WS. Similarly, if you enter WS8000, the H-ADCP uses a value of 1600 cm for WS.

WT - Transmit Length

Purpose	Selects a transmit length different from the depth cell length (cell sampling interval) as set by the WS-command.
Format	WTnnnn
Range	nnnn = 0 to 3200 cm
Default	WT0



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

Description When WT is set to zero, the transmit signal is set to the depth cell size (WS-command). This is the default setting. Setting WT allows selection of a transmit length different then the area depth cell size (sampling length).

WU - Ping Weight

Purpose:	Selects the weight of each ping in an ensemble.
Format	WUn
Range	n = 0 (Box weighting), 1 (Triangle weighting)

Default WU0



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

Description The WU command allows the user to choose the ensemble weighting method. WU0 selects Box weighting which is a simple average of the velocities in each ensemble. WU1 selects Triangle weighting, where the first and last velocities are weighted the least, and the middle velocity is weighted the most.

Example For an ensemble of 5 pings, the weights would appear as below.

Table 37: Ping Weights

	Ping 1	Ping 2	Ping 3	Ping 4	Ping 5
WU0	1	1	1	1	1
WU1	1/3	2/3	1	2/3	1/3



NOTE. The velocity reported for each ensemble is calculated as the sum of the weighted velocities divided by the sum of the weights.

WV – Ambiguity Velocity

Purpose Sets the radial ambiguity velocity.

Format WVnnn

Range nnn = 2 to 700 cm/s

Default WV185



Recommended Setting. It is strongly recommended that the WV command be left at its' default value of 185.

Description Set WV as low as possible to attain maximum performance, but not too low or ambiguity errors will occur. Rule of thumb: Set WV to the maximum relative horizontal velocity between water-current speed and H-ADCP speed.

The WV command (ambiguity velocity setting) sets the maximum velocity that can be measured along the beam when operating in water mode 1 (WM1). WV is used to improve the single-ping standard deviation. The lower the value of the WV command, the lower the single-ping standard deviation.

You are required to set the WV command based on the maximum apparent velocity (ADCP motion plus water speed). The following formula is used to determine the setting of the WV command: $WV = (\text{Max. Apparent Vel. cm/s}) * \sin(\text{beam angle}) * 1.2$



NOTE. Note that the minimum setting of the WV command is WV002 and the maximum setting due to internal processing limitations is limited based on the setting of the bandwidth command, WB.

WV is limited to 330 cm/s in Narrow bandwidth mode (WB1), which increases the profiling range by 10% compared to Broad bandwidth mode (WB0).

When the WB command is set to WB0, the max value is WV700.

In either case, while you can set a value as low as 2 cm/s, this will likely cause ambiguity errors. TRDI recommends setting WV to ≥ 100 cm/s for most applications.

Table 38: WV-command Maximum Setting (20 Degree)

WB Command	Bandwidth	WV (max cm/s)	Apparent Velocity (max cm/s)
0	25%	700	1,705
1	12%	330	804

Example If the maximum expected H-ADCP velocity (vessel velocity) is 250 cm/s (≈ 5 kt) and the maximum expected horizontal water velocity is 100 cm/s, set WV to 350 cm/s.

WW – Mode 1 Pings before Mode 4 Re-Acquire

Purpose	Sets the number of Mode 1 pings sent before a Mode 4 ping is attempted.
Format	WWnnn
Range	nnn = 0 to 999 pings
Default	WW4
Description	WW is the number of Mode 1 pings generated by the H-ADCP before a Mode 4 ping is tried. The H-ADCP uses this value when Mode 4 is in use and the bottom is lost. If WW=0, the H-ADCP continually tries to generate Mode 4 pings.

WY – Mode 1 Bandwidth

Purpose	Sets the profiling Mode 1 bandwidth (sampling rate) and the radial ambiguity velocity.
Format	WY <i>b,aaa</i>
Range	<i>b</i> = 0 (Wide), 1 (Narrow) <i>aaa</i> = 2 to 700 cm/s (330 cm/s in Narrow mode)
Default	WY1,185



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

Description	The WY command sets the WB and WV commands using one command. For more information, see WB - Mode 1 Bandwidth Control and WV – Ambiguity Velocity .
Example	Setting the WY command to WY0,175 will set the WB command to WB0 and the WV command to WV175.

11 Advanced Commands

The following sections describe the advanced commands available for the H-ADCPs.

11.1 Sound Velocity Smart Sensor Commands

The H-ADCP uses these commands for Sound Velocity Smart Sensor (SVSS) applications.

11.1.1 Available Sound Velocity Smart Sensor Command

```
>d?
Available Commands:

DW 0 ----- Current ID on RS-485 Bus
DB 411 ----- RS-485 Port Control (Baud; N/U; N/U)
DX ----- Set SVSS to RAW Mode
DY ----- Set SVSS to REAL Mode
DZ ----- Get Single SCAN from SVSS
DS 20081 0 ----- Load SpeedOfSound with SVSS Sample (BITResult)
D? ----- Display SVSS Commands

>
```

11.1.2 Sound Velocity Smart Sensor Command Descriptions

DB - RS-485 Port Control

Purpose	Change the communication parameters of the RS-485 bus.
Format	DBxyz
Range	x = 0 to 7 Baud Rate, see CB - Serial Port Control . y = 1 to 5 Unused z = 1 to 2 Unused
Default	DB411



Recommended Setting. Use as needed.

Description	This command changes the communication parameters of the RS-485 bus. Currently only the Baud Rate is changed, but all parameters are still required.
-------------	--

DS - Load SpeedOfSound with SVSS Sample (BIT Result)

Purpose	Load the SpeedOfSound variable with a single real scan from the SVSS.
Format	DS



Recommended Setting. Use as needed.

Description This command loads the SpeedOfSound variable with a measured value from the SVSS, in a manner similar to the manner the variable is loaded during deployment. The EZ command must be issued prior to this command or the function will be bypassed. Set the EZ command to EZ3xxxxxx. The three enables communication with the SVSS. Upon successful completion of the function call, the SpeedOfSound variable will contain the new value. Any errors in the function will result in the BIT Result (Table 45) = xxxxxlxx xxxxxxxx which is displayed after the value.

DW - Current ID on RS-485 Bus

Purpose Change the device ID sent out before attempting to communicate.

Format DWx

Range x = 0 to 31

Default DW0



Recommended Setting. Use as needed.

Description This command sets the RS-485 Bus ID and sends the ID out onto the bus with the parity forced high. This wakes up the slave device for communications.

DX - Set SVSS to RAW Mode

Purpose Set the SVSS to Raw mode.

Format DX



Recommended Setting. Use as needed.

Description This command sends “RA” out on the RS-485 bus. If the SVSS is listening, it will change its data output mode to RAW. RAW data is columnar uncalibrated counts.

DY - Set SVSS to REAL Mode

Purpose Set the SVSS to Real mode.
Format DY



Recommended Setting. Use as needed.

Description This command sends “RE” out on the RS-485 bus. If the SVSS is listening, it will change its data output mode to REAL. REAL data is in units of m/s and the form XXXX.XX

DZ - Get Single SCAN from SVSS

Purpose This command gets a single scan of data from the SVSS.
Format DZ



Recommended Setting. Use as needed.

Description This command sends “s” out on the RS-485 bus. If the SVSS is listening, it will respond (-23ms later) with one scan of data. The data format will be determined by the last format command (“DX” or “DY”) sent to the SVSS. The data will be echoed back by the H-ADCP.

11.2 Waves Commands



NOTE. Waves is a feature upgrade for 300 kHz NB H-ADCPs (see [Feature Upgrades](#)).

For information on how to use the Waves commands, see the Waves User's Guide.

11.2.1 Available Waves Commands

```
>h?
Available Commands:

HA 255 ----- Waves False Target Threshold (Fish Rejection)
HB 05 ----- Number of Automatically Chosen Bins (20 Max)
HD 111000000 ----- Waves Selected Data (Vel;Pres;Surf HPR;;)
HF 00000 ----- Waves Flow Ctrl (Res;Res;Res;Ser;Rec)
HP 0000 ----- Number of Pings per Record
HR 01:00:00.00 ----- Time between Wave Bursts (hh:mm:ss.ff)
HS 001,010,021,022,023 --- Bins selected for Directional wave data recording
HT 00:00:00.50 ----- Time between Wave Pings (hh:mm:ss.ff)
HV 001,010,021,022,023 --- Bins selected for Velocity Spectrum data recording
H? ----- Display Waves Menu Help

>
```

11.2.2 Waves Command Descriptions

HA – Waves False Target Threshold

Purpose	Sets a false target (fish) filter.
Format	HA nnn
Range	$nnn = 0$ to 255 counts (255 disables this filter)
Default	HA255



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

Description	The H-ADCP uses the HA-command to screen water-track data for false targets (usually fish). HA sets the maximum difference between echo intensity readings among the four profiling beams. If the HA threshold value is exceeded, the H-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.
-------------	--

HB – Automatically Chosen Bins for Wave Processing

Purpose	Set the number of automatically chosen bins for doing Directional Wave Spectra.
Format	HB n

Range $n = 1$ to 20 bins ($n = 0$ disables auto-bin selection)
 Default HB5



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

Description Bins are selected consecutively starting below the “contaminated area.” If more than three bins are selected, and there are sufficient bins in the column, a mid column beam will be selected. If more than four bins are selected, and there are sufficient bins in the column, the first bin will be selected.

HD – Waves Data Out

Purpose Select the data output in the Waves Packet Structure.
 Format HD *abc def ghi*
 Range *abc def ghi* can be 1 (On) or 0 (Off).
 Default HD 111 000 000



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

Description This command selects which data will be output in the waves packet data.
a – Velocity
b – Pressure
c – Surface Track
d – Heading, Pitch, and Roll
e-i – Reserved

HF – Waves Flow Control

Purpose Sets various H-ADCP waves data flow-control parameters.
 Format HF*nnnnnn*
 Range Firmware switches (Res;Res;Res;Ser;Rec) see Table 39
 Default HF000000



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

Description The HF command is similar to the CF command (see [CF - Flow Control](#)). When the HF command is HF22222 (default), it uses the same settings as the CF command. The HF and CF commands control if the data goes to the recorder and/or to the serial port. This allows you to output Waves data (packets) independently from the standard water current profiles.

Table 39: Waves Flow Control

Command	Description
HFxxx22	Use the same settings as the CF command (default)
HFxxx1x	Enable Serial Output – Sends the currents and waves data ensemble out the RS-232/422 serial interface.
HFxxx0x	Disable Serial Output – No waves ensemble data are sent out the RS-232/422 interface.
HFxxx1	Enable Data Recorder – Records waves data ensembles on the recorder (if installed).
HFxxx0	Disable Data Recorder – No waves data ensembles are recorded on the recorder.



NOTE. The default HF22222 will be displayed as HF00000 when a “HF?” command is run.

HP – Waves Pings per Wave Record

Purpose	Set the number of pings per wave record.
Format	HP <i>n</i>
Range	<i>n</i> = 0 to 8400
Default	HP0



Recommended Setting. Set using *WavesPlan*.

Description	The command sets the number of pings collected per wave record (or burst). With this value set to zero, Waves data collection is disabled.
-------------	--

HR – Time Between Wave Records

Purpose	Set the maximum interval between the start of each wave record.
Format	HR <i>hh:mm:ss.xx</i> <i>hh</i> – hours <i>mm</i> – minutes <i>ss</i> – seconds <i>xx</i> – hundredths of seconds
Range	00:00:00.00 – 23:59:59.99
Default	HR01:00:00.00



Recommended Setting. Set using *WavesPlan*.

Description	This command sets the maximum interval between the start of consecutive wave records. If the number of pings per record * the time between pings is greater than the time between wave
-------------	--

records, then the previous wave record will complete before starting the next one.

HS – Bins for Directional Wave Spectrum

Purpose	Set the list of bins to use for directional wave spectrum data if the H-ADCP is not selecting bins automatically.
Format	HS n1,n2...n20(Max)
Range	n? = 1 - # of Water Profiling Bins (WN).
Default	HS1, 10, 21, 22, 23



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

Description	This command sets the bins to be used for directional wave spectrum processing if automatic bin selection is off. The list can contain a maximum of 20 bins. The limit of each element in the list is set by the number of current profiling bins being collected. This list is completely separate from the Velocity Spectrum bin list, to allow the selection of different bins for Directional Wave and Velocity Spectrum processing.
Example	If automatic bin selection is turned off (HB = 0), and the H-ADCP is collecting 50 bins of current profiling data, the highest single element in the list n1-n20 is limited to 50.

HT – Time Between Wave Record Pings

Purpose	Set the maximum interval between each wave ping.
Format	HT <i>hh:mm:ss.xx</i> <i>hh</i> – hours <i>mm</i> – minutes <i>ss</i> – seconds <i>xx</i> – hundredths of seconds
Range	00:00:00.00 – 23:59:59.99
Default	HT00:00:00.50



Recommended Setting. Set using *WavesPlan*.

Description	This command sets the maximum interval between consecutive wave pings. If the number of pings per record * the time between pings is greater than the time between wave records, then the previous wave record will complete before starting the next one.
-------------	--

HV – Bins for Velocity Spectrum

Purpose	Set the list of bins to use for velocity spectrum data if the H-ADCP is not selecting bins automatically.
Format	HV n1,n2...n20(Max)
Range	n? = 1 - # of Water Profiling Bins (WN).
Default	HV1, 10, 21, 22, 23



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

Description	This command sets the bins to be used for velocity spectrum processing if automatic bin selection is off. The list can contain a maximum of 20 bins. The limit of each element in the list is set by the number of current profiling bins being collected. This list is complete separate from the Directional Wave Spectrum bin list, to allow the selection of different bins for Directional Wave and Velocity Spectrum processing.
Example	If automatic bin selection is turned off (HB = 0), and the H-ADCP is collecting 50 bins of current profiling data, the highest single element in the list n1-n20 is limited to 50.

11.3 Ping Synchronization Commands

The Teledyne RD Instruments Sleepy Sensor Synchronization (TRDS³) protocol allows an H-ADCP to synchronize measurements with another H-ADCP or any other instrument that adheres to the RDS³ specification.

11.3.1 Available Ping Synchronization Commands

```
>s?
SA = 001 ----- Synch Before/After Ping/Ensemble Bottom/Water/Both
SB = 1 ----- Enable Channel B Breaks (1=YES,0=NO)
SI = 00000 ----- Synch Interval (0-65535)
SM = 0 ----- Mode Select (0=OFF,1=MASTER,2=SLAVE,3=NEMO)
SS = 0 ----- RDS3 Sleep Mode (0=No Sleep)
ST = 00000 ----- Slave Timeout (seconds,0=indefinite)
SW = 00000 ----- Synch Delay (1/10 msec)
>
```

11.3.2 Ping Synchronization Command Descriptions

SA - Synchronize Before/After Ping/Ensemble

Purpose	Sets the rough timing of the synchronization pulse.
Format	SAxyz
Range	$x = 0, 1$ $y = 0, 1$ $z = 0, 1, 2$
Default	SA001



Recommended Setting. Special applications only.



NOTE. This command has no effect unless SM = 1 or 2.

Description Use the SA command to set the rough timing of the synchronization pulse. The first parameter determines whether the Master (or Slave) will send (or wait for) a synchronization pulse before or after the conditions set in parameters y and z. If the second parameter is set to Ping, the third parameter determines what kind of ping to synchronize on. If parameter y is set to Ensemble, the third parameter is ignored (but must still be entered).

Table 40: Synchronization Parameters

Parameter	Description
SA000	Send (wait for) pulse before a bottom ping.
SA001	Send (wait for) pulse before a water ping.
SA002	Send (wait for) pulse before both pings
SA100	Send (wait for) pulse after a bottom ping.
SA101	Send (wait for) pulse after a water ping.
SA102	Send (wait for) pulse after both pings.
SA01X	Send (wait for) pulse before ensemble.
SA11X	Send (wait for) pulse after ensemble.

SB – Enable Channel B Breaks

Purpose	Allows the H-ADCP to ignore a <Break> on the Channel B RS-422 lines.
Format	SB <i>n</i>
Range	<i>x</i> = 0 (disable hardware-break detection on Channel B) <i>x</i> = 1 (enable hardware-break detection on Channel B)
Default	SB1

**Recommended Setting.** Special applications only.

Description Set SB0 to prevent noise from being processed as a <Break> on the RS-422 lines. This command is used when another system is connected to the H-ADCP over the RS-422 lines. In this configuration, disconnecting or connecting the other system can cause the H-ADCP to interpret this as a <Break> over Channel B. A break will cause the H-ADCP to stop pinging and the deployment will be interrupted.

To set the SB command to SB0, do the following.

7. Send SB0.
8. Immediately following the SB0 command, send a Break (see [Break](#)).
9. The SB0 command is now in effect and the H-ADCP will ignore potential <Breaks> on the Channel B RS-422 lines.

**NOTE.** The SB command is not affected by the CR command (see [CR – Retrieve Parameters](#))

This command is available in firmware versions 11.08 and higher.

SI - Synchronization Interval

Purpose	Sets how many pings/ensembles to wait before sending the next synchronization pulse.
Format	SI <i>nnnnn</i>
Range	<i>nnnnn</i> = 0 to 65535
Default	SI0

**Recommended Setting.** Special applications only.



NOTE. This command has no effect unless SM = 1

Description Use the SI command to set how many pings/ensembles (depending on the SA command) to wait before sending the next synchronization pulse.

SM - RDS3 Mode Select

Purpose Sets the RDS3 Mode.
Format SM n
Range $n = 0$ (Off), 1 (RDS3 Master), 2 (RDS3 Slave), 3 (NEMO)
Default SM0



Recommended Setting. Special applications only.

Description SM sets the RDS3 Mode. SM0 turns off the RDS3 mode and disables all other commands on this menu. SM1 sets the RDS3 Master mode and enables the SA, SI, SS, and SW commands. SM2 sets the RDS3 Slave mode and enables the SA, SS, and ST commands. SM3 sets the NEMO Mode and enables the SW command.



NOTE. When the SM command is used, the communication switch on the H-ADCP's PIO board must be in the RS232 position.

SS - RDS3 Sleep Mode

Purpose Sets the RDS3 Sleep Mode.
Format SS x
Range $x = 0, 1$ (0 = No Sleep, 1 = Sleep)
Default SS0



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



NOTE. This command has no effect unless SM = 1 or 2

Description This command sets the RDS3 Sleep Mode. When x is set to No Sleep, the instrument remains awake while waiting for the next ping time (or synchronization pulse) in a loop. When x is set to Sleep, the instrument sleeps between pings (or synchro-

nization pulses.) There are limitations to using the Sleep Mode. A TRDI WH, setup as a slave, can only synchronize to within 2.5 ms of the Master. When the Slave is in No Sleep Mode, the slave can ping to within 500 microseconds of the master. The benefits of power saving cost are synchronization accuracy.

Table 41: Sleep Mode Parameters

Parameter	Description
SS0	Wait between pings (synchronization pulses) in a loop.
SS1	Wait between pings (synchronization pulses) in a sleep state.

ST - Slave Timeout

Purpose	Sets the amount of time a slave will wait to hear a synch pulse before proceeding on its own.
Format	ST n
Range	$n = 0$ to 10800 seconds
Default	ST0



Recommended Setting. Special applications only.



NOTE. This command has no effect unless SM = 2

Description	ST sets the amount of time a slave will wait to hear a synch pulse before proceeding on its own. If a slave times out, it will automatically ping according to the CF, TP, TE, WP, and BP command settings. This is a fail-safe mechanism designed to allow the slave to proceed on its own should communications with the master H-ADCP fail. Setting ST = 0 tells the slave to wait indefinitely.
-------------	---

SW - Synchronization Delay

Purpose	Sets the amount of time to wait after sending the pulse.
Format	SW n
Range	$n = 0$ to 65535 (units of 0.1 milliseconds)
Default	SW00075



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



NOTE. This command has no effect unless SM = 1 or 3

Description Use the SW command to set the amount of time to wait after sending the pulse before proceeding. For example, setting the SW command to SW20000 will add a delay of 2 seconds. This allows precise timing of measurements.

When a Master attempts to ping a slave H-ADCP, it sends out a pulse to the slave H-ADCP. The slave H-ADCP has a different code path than the Master H-ADCP and thus, they will take different amounts of time to start the ping. By adding in the default Master Delay of 7.5 ms, the code paths are evened up to allow the units to start the pings at about the same time (typically within 100 microseconds of each other).

11.3.3 Example Master/Slave Setup

Master Slave Initialization

- Connect the master and slave H-ADCPs to two PC comports via a master/slave cable.
- Apply power to the H-ADCPs.
- Establish RS-232 communications between *BBTalk* and the master and slave H-ADCPs.
- Set both the master and slave H-ADCP to the same baud rate (see Note 1).
- Send a BREAK to the master H-ADCP.
- Verify that the master H-ADCP outputs the RS-232 banner (see Note 2).
- Send a CR1 and CK command to the master H-ADCP.
- Send a BREAK to the slave H-ADCP.
- Verify that the slave H-ADCP outputs the RS-232 banner.

- j. Send a CR1 and CK to the slave H-ADCP.
- k. Send the configuration commands to the master H-ADCP, omitting the CS command to start sampling.
- l. Send the configuration commands to the slave H-ADCP including the CS command to start sampling.
- m. Now send the CS commands to the master H-ADCP.

The master samples, and triggers the slave, which samples. This continues until the power is not available, or the user or some other force intervenes.

Terminating Data Collection

- a. Send a BREAK to the master H-ADCP (see note 2).
- b. Verify that the master H-ADCP outputs the RS-232 banner (see note 2).
- c. Send a CZ command to the master H-ADCP.
- d. Send a BREAK to the slave H-ADCP.
- e. Verify that the slave H-ADCP outputs the RS-232 banner (see note 2).
- f. Send the CZ command to the slave H-ADCP.

NOTE 1.



The master and slave H-ADCP must use the same baud rate. Baud rate options depend on whether the master and slave H-ADCP are allowed to go to low power mode between samples. When the master and slave cannot go to low power mode between samples, the user can select all baud rates less than 115200 (i.e. one can use 1200, 2400, 4800, 9600, 19200, 38400, or 57600 baud).

When master and slave H-ADCP can go to low power mode between samples, the user can select 1200, 2400, 4800, or 9600 baud.

NOTE 2.



The master slave cable connects the units via an RS-485 bus so the master H-ADCP can trigger the slave H-ADCP to sample. The RS-485 bus can alternately be used for RS-422 communications. However, during initialization, when the master H-ADCP receives a BREAK and outputs the wakeup banner, it also may cause the slave H-ADCP to output an incomplete banner. When this occurs, send additional BREAKs to the master H-ADCP until the slave H-ADCP outputs a full RS-422 banner.

Example Wakeup Banners

RS232 Banner

```
[BREAK Wakeup A]  
WorkHorse Broadband H-ADCP Version 11.08  
Teledyne RD Instruments (c) 1996-2007  
All Rights Reserved.  
>
```

RS422 Banner

```
[BREAK Wakeup B]  
WorkHorse Broadband H-ADCP Version 11.08  
Teledyne RD Instruments (c) 1996-2007  
All Rights Reserved.  
>
```

Incomplete Banner

```
[BR
```

12 Introduction to Output Data Format

This section shows the output data format of the H-ADCP. H-ADCP output data can be in either hexadecimal-ASCII or binary format. You can select this option through the CF-command (see the [CF - Flow Control](#)). We explain the output data formats in enough detail to let you create your own data processing or analysis programs (see [How to Decode an H-ADCP Ensemble](#)).

12.1 Hexadecimal-ASCII Output Data

Use the hexadecimal-ASCII (Hex ASCII) format (CFxx0xx) when you are viewing raw H-ADCP data on a computer/dumb terminal. This format uses the standard ASCII codes for 0 through F to represent numeric values as hexadecimal digits. Other standard ASCII characters (text) and control commands (carriage return, line feed, end of file, etc.) are interpreted normally. In the Hex ASCII mode, the H-ADCP sends data in one line of ASCII characters. There are no carriage returns and/or line feed sequences (CR/LF) sent from the H-ADCP. The CRT provides a CR/LF after 60 characters.



NOTE. Hex ASCII PD0 data is not supported by TRDI's software.

12.2 Binary Output Data Format

Use the binary format (CFxx1xx) when recording/processing H-ADCP data on an external device. The binary format uses less storage space and has a faster transmission time than the Hex ASCII format. A dumb terminal is of little use in binary format because the terminal interprets some of the data as control characters.



NOTE. All of TRDI's software supports binary PD0 formatted data only.

12.3 What Data Format Should I Use and Why?

The H-ADCP can output data in several user selectable formats using the PD command (see [PD - Data Stream Select](#)). Depending on the output format selected, data will be either binary or ASCII text. Individual parameters within a data string may be enabled / disabled. All binary output formats have the option of outputting data in HEX-ASCII instead of true binary using the CF command (see [CF - Flow Control](#)). HEX-ASCII is an ASCII representation of the binary data. Binary output formats include PD0, 3, 4, and 5. Text output formats include PD6, and 8.

Deciding on which format to use depends on the needs of the deployment. The following describes the basics of the formats available.

PD0 – PD0 is Teledyne RD Instrument’s standard format. PD0 is a binary output format. It provides the most information possible including a header, fixed and variable leader, bottom track, and water profile information. The fixed and variable leader is a recording of time, H-ADCP setup, orientation, heading, pitch, roll, temperature, pressure, and self test diagnostic results. Data fields to be output are user selectable.

PD3 – PD3 is a binary output format of bottom track speed over the bottom, speed through the water, and range to bottom information.

PD4 – PD4 is a binary output format of bottom track speed over the bottom, speed through the water, and range to bottom information.

PD5 – PD5 is a superset of PD4 and includes information on salinity, depth, pitch, roll, heading, and distance made good.

PD6 – PD6 is a text output format. Data is grouped into separate sentences containing system attitude data, timing and scaling, and speed through the water relative to the instrument, vehicle, and earth. Each sentence contains a unique starting delimiter and comma delimited fields.

PD8 – PD8 outputs ensemble data as formatted text. A new-line character terminates each line. Two new-line characters terminate an ensemble. PD8 data is only for serial output; the H-ADCP will output PD8 ASCII data out the serial port and record PD0 data to the recorder card (if enabled).

PD14 – is the standard output used with WorkHorse H-ADCPs.

Special Application Output Formats

PD16 and **PD18** – are for use with Sea-Bird acoustic modems.

The following table is a summary of the type of data outputted by PD0 through PD14 data output formats. Note that this is not an exhaustive list and it is advised to check out the full description of a format before choosing it above another.

Table 42: Summary of Output Data Formats

	PD0	PD3	PD4	PD5	PD6	PD8	PD14
System Info	✓		✓	✓			
Temperature	✓	✓	✓	✓	✓	✓	✓
Depth	✓			✓	✓		✓
Tilts (H,P,R)	✓	✓		✓	✓	✓	✓
Time of Ping	✓	✓	✓	✓	✓	✓	✓
Speed of Sound	✓		✓	✓	✓	✓	
Water Profile Configuration	✓						
Water Profile Velocities	✓					✓	
Correlation Magnitude	✓					✓	
Echo Intensity	✓					✓	
Percent Good	✓						
Bottom Range	✓	✓	✓	✓	✓		✓
Bottom Velocity (SOG*)	✓	✓	✓	✓	✓		✓
Water-Mass Layer Velocity (STW*)	✓	✓	✓	✓	✓		✓
Bottom Track Configuration	✓						
Distance Over Ground				✓			
Binary	✓	✓	✓	✓	✓	✓	✓
ASCII					✓		
Serial Output						✓	

*SOG = Speed Over Ground

*STW = Speed Through Water

13 PD0 Output Data Format

The following description is for the standard PD0 H-ADCP output data format. Figure 40 through Figure 47 shows the ASCII and binary data formats for the H-ADCP PD0 mode. Table 43 through Table 52 defines each field in the output data structure.

After completing a data collection cycle, the H-ADCP immediately sends a data ensemble. The following pages show the types and sequence of data that you may include in the H-ADCP output data ensemble and the number of bytes required for each data type. The H-ADCP sends all the data for a given type for all depth cells and all beams before the next data type begins.

The H-ADCP by default is set to collect velocity, correlation data, echo intensity, and percent good data. The data, preceded by ID code 7F7F, contains header data (explained in Table 43). The fixed and variable leader data is preceded by ID codes 0000 and 8000, (explained in Table 44 and Table 45). The H-ADCP always collects Header and Leader.

The remaining lines include velocity (ID Code: 0001), correlation magnitude (0002), echo intensity (0003), and percent good (0004). The final field is a data-validity checksum.

ALWAYS OUTPUT	HEADER (6 BYTES + [2 x No. OF DATA TYPES])
	FIXED LEADER DATA (59 BYTES)
	VARIABLE LEADER DATA (65 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)
BP-command	BOTTOM TRACK DATA (85 BYTES)
ALWAYS OUTPUT	RESERVED (2 BYTES)
	CHECKSUM (2 BYTES)

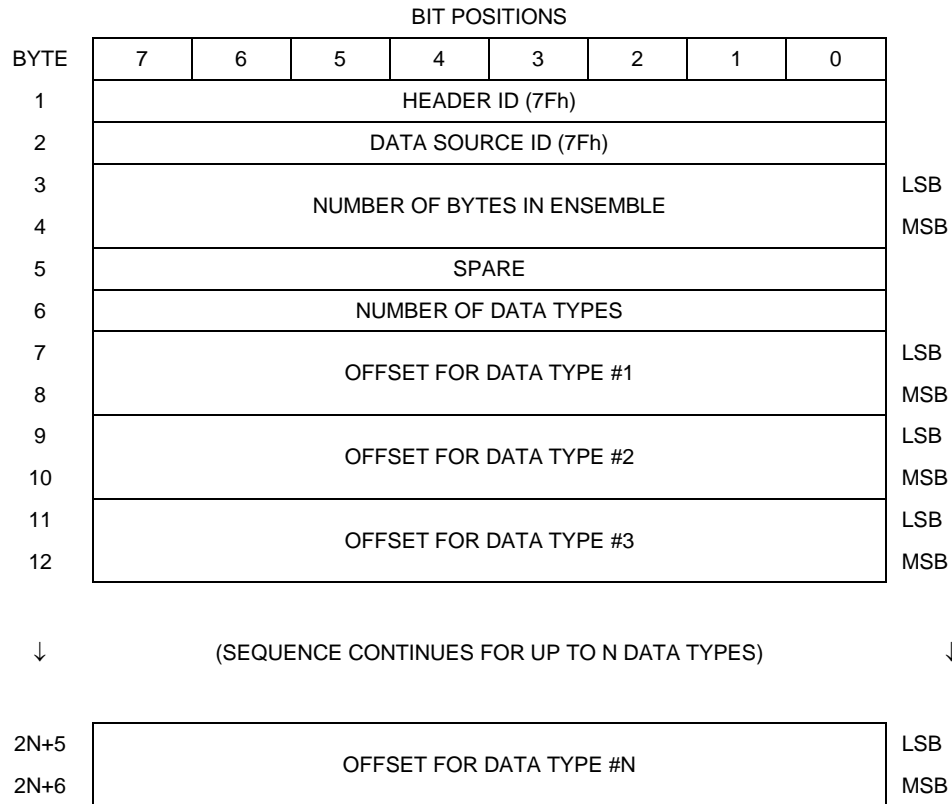
Figure 39. PD0 Standard Output Data Buffer Format

Some data outputs are in bytes per depth cell. For example, if the WN-command (number of depth cells) = 30 (default), WD command = WD 111 100 000 (default), WP command > 0, BP command > 0, the required data buffer storage space is 841 bytes per ensemble.

There are seven data types output for this example: Fixed Leader, Variable Leader, Velocity, Correlation Magnitude, Echo Intensity, Percent Good, and Bottom Track.

20	BYTES OF HEADER DATA (6 + [2 x 7 Data Types])
59	BYTES OF FIXED LEADER DATA (FIXED)
65	BYTES OF VARIABLE LEADER DATA (FIXED)
242	BYTES OF VELOCITY DATA (2 + 8 x 30)
122	BYTES OF CORRELATION MAGNITUDE DATA (2 + 4 x 30)
122	BYTES OF ECHO INTENSITY (2 + 4 x 30)
122	BYTES OF PERCENT-GOOD DATA (2 + 4 x 30)
85	BYTES OF BOTTOM TRACK DATA (FIXED)
2	BYTES OF RESERVED FOR TRDI USE (FIXED)
2	BYTES OF CHECKSUM DATA (FIXED)
<hr/>	
841	BYTES OF DATA PER ENSEMBLE

13.1 Header Data Format



See Table 43 for a description of the fields.

Figure 40. Binary Header Data Format

Header information is the first item sent by the H-ADCP to the output buffer. The H-ADCP always sends the Least Significant Byte (LSB) first.

Table 43: 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 H-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 (Figure 47).
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 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 H-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 H-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 H-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).

13.2 Fixed Leader Data Format

BIT POSITIONS									
BYTE	7	6	5	4	3	2	1	0	
1	FIXED LEADER ID								LSB 00h
2									MSB 00h
3	CPU F/W VER.								
4	CPU F/W REV.								
5	SYSTEM CONFIGURATION								LSB
6									MSB
7	REAL/SIM FLAG								
8	LAG LENGTH								
9	NUMBER OF BEAMS								
10	NUMBER OF CELLS {WN}								
11	PINGS PER ENSEMBLE {WP}								LSB
12									MSB
13	DEPTH CELL LENGTH {WS}								LSB
14									MSB
15	BLANK AFTER TRANSMIT {WF}								LSB
16									MSB
17	PROFILING MODE {WM}								
18	LOW CORR THRESH {WC}								
19	NO. CODE REPS								
20	%GD MINIMUM {WG}								
21	ERROR VELOCITY MAXIMUM {WE}								LSB
22									MSB
23	TPP MINUTES								
24	TPP SECONDS								
25	TPP HUNDREDTHS {TP}								
26	COORDINATE TRANSFORM {EX}								
27	HEADING ALIGNMENT {EA}								LSB
28									MSB

Continued Next Page

Continued from Previous Page

29	HEADING BIAS {EB}	LSB
30		MSB
31	SENSOR SOURCE {EZ}	
32	SENSORS AVAILABLE	
33	BIN 1 DISTANCE	
34		
35	XMIT PULSE LENGTH BASED ON {WT}	LSB
36		MSB
37	(starting cell) WP REF LAYER AVERAGE {WL} (ending cell)	LSB
38		MSB
39	FALSE TARGET THRESH {WA}	
40	SPARE	
41	TRANSMIT LAG DISTANCE	LSB
42		MSB
43	CPU BOARD SERIAL NUMBER	LSB
↓		↓
50		MSB
51	SYSTEM BANDWIDTH {WB}	LSB
52		MSB
53	SYSTEM POWER {CQ}	
54	SPARE	
55	INSTRUMENT SERIAL NUMBER	
↓		
58		
59	BEAM ANGLE	

See Table 44 for a description of the fields

Figure 41. Fixed Leader Data Format

Fixed Leader data refers to the non-dynamic H-ADCP data that only changes when you change certain commands. Fixed Leader data also contains hardware information. The H-ADCP always sends Fixed Leader data as output data (LSBs first).

Table 44: Fixed Leader Data Format

Hex Digit	Binary Byte	Field	Description																																																																																																																																																																																																																																																
1-4	1,2	FID / Fixed Leader ID	Stores the Fixed Leader identification word (00 00h).																																																																																																																																																																																																																																																
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	<div>This field defines the H-ADCP hardware configuration. Convert this field (2 bytes, LSB first) to binary and interpret as follows.</div> <div>LSB</div> <table><tr><td>BITS</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td><td></td></tr><tr><td></td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>0</td><td>0</td><td>0</td><td>75-kHz SYSTEM</td></tr><tr><td></td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>0</td><td>0</td><td>1</td><td>150-kHz SYSTEM</td></tr><tr><td></td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>0</td><td>1</td><td>0</td><td>300-kHz SYSTEM</td></tr><tr><td></td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>0</td><td>1</td><td>1</td><td>600-kHz SYSTEM</td></tr><tr><td></td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>1</td><td>0</td><td>0</td><td>1200-kHz SYSTEM</td></tr><tr><td></td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>1</td><td>0</td><td>1</td><td>2400-kHz SYSTEM</td></tr><tr><td></td><td>-</td><td>-</td><td>-</td><td>-</td><td>0</td><td>-</td><td>-</td><td>-</td><td>CONCAVE BEAM PAT.</td></tr><tr><td></td><td>-</td><td>-</td><td>-</td><td>-</td><td>1</td><td>-</td><td>-</td><td>-</td><td>CONVEX BEAM PAT.</td></tr><tr><td></td><td>-</td><td>-</td><td>0</td><td>0</td><td>-</td><td>-</td><td>-</td><td>-</td><td>SENSOR CONFIG #1</td></tr><tr><td></td><td>-</td><td>-</td><td>0</td><td>1</td><td>-</td><td>-</td><td>-</td><td>-</td><td>SENSOR CONFIG #2</td></tr><tr><td></td><td>-</td><td>-</td><td>1</td><td>0</td><td>-</td><td>-</td><td>-</td><td>-</td><td>SENSOR CONFIG #3</td></tr><tr><td></td><td>-</td><td>0</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>XDCR HD NOT ATT.</td></tr><tr><td></td><td>-</td><td>1</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>XDCR HD ATTACHED</td></tr><tr><td></td><td>0</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>DOWN FACING BEAM</td></tr><tr><td></td><td>1</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>UP-FACING BEAM</td></tr></table> <div>MSB</div> <table><tr><td>BITS</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td><td></td></tr><tr><td></td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>0</td><td>0</td><td>15E BEAM ANGLE</td></tr><tr><td></td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>0</td><td>1</td><td>20E BEAM ANGLE</td></tr><tr><td></td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>1</td><td>0</td><td>30E BEAM ANGLE</td></tr><tr><td></td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>1</td><td>1</td><td>OTHER BEAM ANGLE</td></tr><tr><td></td><td>0</td><td>1</td><td>0</td><td>0</td><td>-</td><td>-</td><td>-</td><td>-</td><td>4-BEAM JANUS CONFIG</td></tr><tr><td></td><td>0</td><td>1</td><td>0</td><td>1</td><td>-</td><td>-</td><td>-</td><td>-</td><td>5-BM JANUS CFG DEMOD)</td></tr><tr><td></td><td>1</td><td>1</td><td>1</td><td>1</td><td>-</td><td>-</td><td>-</td><td>-</td><td>5-BM JANUS CFG. (2 DEMD)</td></tr></table> <div>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).</div>	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		-	-	-	-	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	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 CFG DEMOD)		1	1	1	1	-	-	-	-	5-BM JANUS CFG. (2 DEMD)
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																																																																																																																																																																																																																																										
	-	-	-	-	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																																																																																																																																																																																																																																										
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 CFG DEMOD)																																																																																																																																																																																																																																										
	1	1	1	1	-	-	-	-	5-BM JANUS CFG. (2 DEMD)																																																																																																																																																																																																																																										
13,14	7	PD / Real/Sim Flag	This field is set by default as real data (0).																																																																																																																																																																																																																																																

Continued next page

Table 44: Fixed Leader Data Format (continued)

Hex Digit	Binary Byte	Field	Description
15,16	8	Lag Length	Lag Length. The lag is the time period between sound pulses. This is varied, and therefore of interest in, at a minimum, for the WM5, WM8 and WM11 and BM7 commands.
17,18	9	#Bm / Number of Beams	Contains the number of beams used to calculate velocity data (not physical beams). Table 49 (Percent-Good Data Format) has more information.
19,20	10	WN / Number of Cells	Contains the number of depth cells over which the H-ADCP collects data (WN-command). 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 H-ADCP does not collect the WD water-profile data. Note: The H-ADCP automatically extends the ensemble interval (TE) if the product of WP and time per ping (TP) is greater than TE (i.e., if $WP \times TP > TE$). Scaling: LSD = 1 ping; Range = 0 to 16,384 pings
25-28	13,14	WS / Depth Cell Length	Contains the length of one depth cell (WS-command). 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 H-ADCP to allow the transmit circuits time to recover before the receive cycle begins (WF-command). Scaling: LSD = 1 centimeter; Range = 0 to 9999 cm (328 feet)
33,34	17	Signal Processing Mode	Contains the Signal Processing Mode. This field will always be set to 1.
35,36	18	WC / Low Corr Thresh	Contains the minimum threshold of correlation that water-profile data can have to be considered good data (WC-command). Scaling: LSD = 1 count; Range = 0 to 255 counts
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	WG / %Gd 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 H-ADCP flags all four beams of the affected bin as bad. Scaling: LSD = 1 mm/s; Range = 0 to 5000 mm/s
45,46	23	Minutes	These fields, set by the TP-command, contain the amount of time between ping groups in the ensemble. NOTE: The H-ADCP automatically extends the ensemble interval (set by TE) if $(WP \times TP > TE)$.
47,48	24	Seconds	
49,50	25	Hundredths	

Table 44: Fixed Leader Data Format (continued)

Hex Digit	Binary Byte	Field	Description																
51,52	26	EX / Coord Transform	<p>Contains the coordinate transformation processing parameters (EX-command). These firmware switches indicate how the H-ADCP collected data.</p> <p>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</p>																
53-56	27,28	EA / Heading Alignment	<p>Contains a correction factor for physical heading misalignment (EA-command).</p> <p>Scaling: LSD = 0.01 degree; Range = -179.99 to 180.00 degrees</p>																
57-60	29,30	EB / Heading Bias	<p>Contains a correction factor for electrical/magnetic heading bias (EB-command).</p> <p>Scaling: LSD = 0.01 degree; Range = -179.99 to 180.00 degrees</p>																
61,62	31	EZ / Sensor Source	<p>Contains the selected source of environmental sensor data (EZ-command). These firmware switches indicate the following.</p> <table><thead><tr><th>FIELD</th><th>DESCRIPTION</th></tr></thead><tbody><tr><td>xlxxxxxx</td><td>CALCULATES EC (SPEED OF SOUND) FROM ED, ES, AND ET</td></tr><tr><td>xxlxxxxx</td><td>USES ED FROM DEPTH SENSOR</td></tr><tr><td>xxx1xxxx</td><td>USES EH FROM TRANSDUCER HEADING SENSOR</td></tr><tr><td>xxxx1xxx</td><td>USES EP FROM TRANSDUCER PITCH SENSOR</td></tr><tr><td>xxxxx1xx</td><td>USES ER FROM TRANSDUCER ROLL SENSOR</td></tr><tr><td>xxxxxx1x</td><td>USES ES (SALINITY) FROM CONDUCTIVITY SENSOR</td></tr><tr><td>xxxxxxx1</td><td>USES ET FROM TRANSDUCER TEMPERATURE SENSOR</td></tr></tbody></table> <p>NOTE: If the field = 0, or if the sensor is not available, the H-ADCP uses the manual command setting. If the field = 1, the H-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 H-ADCP only displays a 0 (manual) or 1 (int/ext sensor).</p>	FIELD	DESCRIPTION	xlxxxxxx	CALCULATES EC (SPEED OF SOUND) FROM ED, ES, AND ET	xxlxxxxx	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 (SALINITY) FROM CONDUCTIVITY SENSOR	xxxxxxx1	USES ET FROM TRANSDUCER TEMPERATURE SENSOR
FIELD	DESCRIPTION																		
xlxxxxxx	CALCULATES EC (SPEED OF SOUND) FROM ED, ES, AND ET																		
xxlxxxxx	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 (SALINITY) FROM CONDUCTIVITY SENSOR																		
xxxxxxx1	USES ET FROM TRANSDUCER TEMPERATURE SENSOR																		
63,64	32	Sensor Avail	<p>This field reflects which sensors are available. The bit pattern is the same as listed for the EZ-command (above).</p>																
65-68	33,34	dis1 / Bin 1 distance	<p>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.</p> <p>Scaling: LSD = 1 centimeter; Range = 0 to 65535 cm (2150 feet)</p>																
69-72	35,36	WT Xmit pulse length	<p>This field, set by the WT-command, contains the length of the transmit pulse. When the H-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 H-ADCP uses a WT <u>command</u> of zero. However, the WT <u>field</u> contains the actual length of the transmit pulse used.</p> <p>Scaling: LSD = 1 centimeter; Range = 0 to 65535 cm (2150 feet)</p>																

Table 44: Fixed Leader Data Format (continued)

Hex Digit	Binary Byte	Field	Description
73,74 75,76	37,38	WL / WP Ref Lyr Avg (Starting cell, Ending cell)	Contains the starting depth cell (LSB, byte 37) and the ending depth cell (MSB, byte 38) used for water reference layer averaging (WL-command). Scaling: LSD = 1 depth cell; Range = 1 to 128 depth cells
77,78	39	WA / False Target Threshold	Contains the threshold value used to reject data received from a false target, usually fish (WA-command). Scaling: LSD = 1 count; Range = 0 to 255 counts (255 disables)
79,80	40	Spare	Contains the CX-command setting. Range = 0 to 5
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
85-100	43-50	CPU Board Serial Number	Contains the serial number of the CPU board.
101-105	51-52	WB / System Bandwidth	Contains the WB-command setting. Range = 0 to 1
106-107	53	System Power	Contains the CQ-command setting. Range 0 to 255.
108-109	54	Spare	Spare
110-119	55-58	Serial #	Instrument serial number
120 -121	59	Beam Angle	Beam angle

13.3 Variable Leader Data Format

BYTE	BIT POSITIONS									
	7	6	5	4	3	2	1	0		
1	VARIABLE LEADER ID								80h	
2									00h	
3	ENSEMBLE NUMBER								LSB	
4									MSB	
5	RTC YEAR {TS}									
6										RTC MONTH {TS}
7										RTC DAY {TS}
8										RTC HOUR {TS}
9										RTC MINUTE {TS}
10										RTC SECOND {TS}
11										RTC HUNDREDTHS {TS}
12	ENSEMBLE # MSB									
13	BIT RESULT								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	MPT MINUTES									
30										MPT SECONDS
31										MPT HUNDREDTHS
32	HDG STD DEV									
33										PITCH STD DEV
34										ROLL STD DEV

Continued Next Page

Continued from Previous Page

35	ADC CHANNEL 0	
36	ADC CHANNEL 1	
37	ADC CHANNEL 2	
38	ADC CHANNEL 3	
39	ADC CHANNEL 4	
40	ADC CHANNEL 5	
41	ADC CHANNEL 6	
42	ADC CHANNEL 7	
43	ERROR STATUS WORD (ESW) {CY?}	LSB
44		
45		
46		MSB
47	SPARE	
48		
49	PRESSURE	LSB
50		
51		
52		MSB
53	PRESSURE SENSOR VARIANCE	LSB
54		
55		
56		MSB
57	SPARE	
58	RTC CENTURY	
59	RTC YEAR	
60	RTC MONTH	
61	RTC DAY	
62	RTC HOUR	
63	RTC MINUTE	
64	RTC SECOND	
65	RTC HUNDREDTH	

See Table 45 for a description of the fields.

Figure 42. Variable Leader Data Format

Variable Leader data refers to the dynamic H-ADCP data (from clocks/sensors) that change with each ping. The H-ADCP always sends Variable Leader data as output data (LSBs first).

Table 45: Variable Leader Data Format

Hex Digit	Binary Byte	Field	Description
1-4	1,2	VID / Variable Leader ID	Stores the Variable Leader identification word (80 00h).
5-8	3,4	Ens / Ensemble Number	<p>This field contains the sequential number of the ensemble to which the data in the output buffer apply.</p> <p>Scaling: LSD = 1 ensemble; Range = 1 to 65,535 ensembles</p> <p>NOTE: The first ensemble collected is #1. At "rollover," we have the following sequence:</p> <pre> 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. </pre>
9,10	5	RTC Year	These fields contain the time from the H-ADCP's real-time clock (RTC) that the current data ensemble began. The TS-command (Set Real-Time Clock) initially sets the clock. The H-ADCP <u>does</u> account for leap years.
11,12	6	RTC Month	
13,14	7	RTC Day	
15,16	8	RTC Hour	
17,18	9	RTC Minute	
19,22	10	RTC Second	
21,22	11	RTC Hundredths	
23-24	12	Ensemble # MSB	This field increments each time the Ensemble Number field (bytes 3,4) "rolls over." This allows ensembles up to 16,777,215. See Ensemble Number field above.
25-28	13,14	BIT / BIT Result	<p>This field contains the results of the H-ADCP's Built-in Test function. A zero code indicates a successful BIT result.</p> <pre> BYTE 13 BYTE 14 (BYTE 14 RESERVED FOR FUTURE USE) 1xxxxxxx xxxxxxxx = RESERVED x1xxxxxx xxxxxxxx = RESERVED xx1xxxxx xxxxxxxx = RESERVED xxx1xxxx xxxxxxxx = DEMOD 1 ERROR xxxx1xxx xxxxxxxx = DEMOD 0 ERROR xxxxx1xx xxxxxxxx = RESERVED xxxxxx1x xxxxxxxx = TIMING CARD ERROR xxxxxxx1 xxxxxxxx = RESERVED </pre>
29-32	15,16	EC / Speed of Sound	<p>Contains either manual or calculated speed of sound information (EC-command).</p> <p>Scaling: LSD = 1 meter per second; Range = 1400 to 1600 m/s</p>

Continued next page

Table 45: Variable Leader Data Format (continued)

Hex Digit	Binary Byte	Field	Description
33-36	17,18	ED / Depth of Transducer	Contains the depth of the transducer below the water surface (ED-command). 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 H-ADCP heading angle (EH-command). 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 H-ADCP pitch angle (EP-command). 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 = -20.00 to +20.00 degrees
45-48	23,24	ER / Roll (Tilt 2)	Contains the H-ADCP roll angle (ER-command). This value may be a manual setting or a reading from a tilt sensor. For up-facing H-ADCPs, positive values mean that Beam #2 is spatially higher than Beam #1. For down-facing H-ADCPs, positive values mean that Beam #1 is spatially higher than Beam #2. Scaling: LSD = 0.01 degree; Range = -20.00 to +20.00 degrees
49-52	25,26	ES / Salinity	Contains the salinity value of the water at the transducer head (ES-command). This value may be a manual setting or a reading from a conductivity sensor. Scaling: LSD = 1 part per thousand; Range = 0 to 40 ppt
53-56	27,28	ET / Temperature	Contains the temperature of the water at the transducer head (ET-command). 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	29	MPT minutes	This field contains the <u>M</u> inimum <u>P</u> re- <u>P</u> ing <u>W</u> ait <u>T</u> ime between ping groups in the ensemble.
59,60	30	MPT seconds	
61,62	31	MPT hundredths	
63,64	32	H/Hdg Std Dev	These fields contain the standard deviation (accuracy) of the heading and tilt angles from the gyrocompass/pendulums. Scaling (Heading): LSD = 1°; Range = 0 to 180° Scaling (Tilts): LSD = 0.1°; Range = 0.0 to 20.0°
65,66	33	P/Pitch Std Dev	
67,68	34	R/Roll Std Dev	

Table 45: Variable Leader Data Format (continued)

Hex Digit	Binary Byte	Field	Description																																																																																																																																																																																																																																																																														
69-70	35	ADC Channel 0	<p>These fields contain the outputs of the Analog-to-Digital Converter (ADC) located on the DSP board. The ADC sequentially samples one of the eight channels per ping group (the number of ping groups per ensemble is the maximum of the WP). These fields are zeroed at the beginning of the deployment and updated each ensemble at the rate of one channel per ping group. For example, if the ping group size is 5, then:</p> <table><tr><td>END OF ENSEMBLE No.</td><td>CHANNELS UPDATED</td></tr><tr><td>Start</td><td>All channels = 0</td></tr><tr><td>1</td><td>0, 1, 2, 3, 4</td></tr><tr><td>2</td><td>5, 6, 7, 0, 1</td></tr><tr><td>3</td><td>2, 3, 4, 5, 6</td></tr><tr><td>4</td><td>7, 0, 8, 2, 3</td></tr><tr><td>↓</td><td>↓</td></tr></table> <p>Here is the description for each channel:</p> <table><tr><th>CHANNEL</th><th>DESCRIPTION</th></tr><tr><td>0</td><td>XMIT CURRENT</td></tr><tr><td>1</td><td>XMIT VOLTAGE</td></tr><tr><td>2</td><td>AMBIENT TEMP</td></tr><tr><td>3</td><td>PRESSURE (+)</td></tr><tr><td>4</td><td>PRESSURE (-)</td></tr><tr><td>5</td><td>ATTITUDE TEMP</td></tr><tr><td>6</td><td>ATTITUDE</td></tr><tr><td>7</td><td>CONTAMINATION SENSOR</td></tr></table> <p>Note that the ADC values may be “noisy” from sample-to-sample, but are useful for detecting long-term trends.</p>	END OF ENSEMBLE No.	CHANNELS UPDATED	Start	All channels = 0	1	0, 1, 2, 3, 4	2	5, 6, 7, 0, 1	3	2, 3, 4, 5, 6	4	7, 0, 8, 2, 3	↓	↓	CHANNEL	DESCRIPTION	0	XMIT CURRENT	1	XMIT VOLTAGE	2	AMBIENT TEMP	3	PRESSURE (+)	4	PRESSURE (-)	5	ATTITUDE TEMP	6	ATTITUDE	7	CONTAMINATION SENSOR																																																																																																																																																																																																																																														
END OF ENSEMBLE No.	CHANNELS UPDATED																																																																																																																																																																																																																																																																																
Start	All channels = 0																																																																																																																																																																																																																																																																																
1	0, 1, 2, 3, 4																																																																																																																																																																																																																																																																																
2	5, 6, 7, 0, 1																																																																																																																																																																																																																																																																																
3	2, 3, 4, 5, 6																																																																																																																																																																																																																																																																																
4	7, 0, 8, 2, 3																																																																																																																																																																																																																																																																																
↓	↓																																																																																																																																																																																																																																																																																
CHANNEL	DESCRIPTION																																																																																																																																																																																																																																																																																
0	XMIT CURRENT																																																																																																																																																																																																																																																																																
1	XMIT VOLTAGE																																																																																																																																																																																																																																																																																
2	AMBIENT TEMP																																																																																																																																																																																																																																																																																
3	PRESSURE (+)																																																																																																																																																																																																																																																																																
4	PRESSURE (-)																																																																																																																																																																																																																																																																																
5	ATTITUDE TEMP																																																																																																																																																																																																																																																																																
6	ATTITUDE																																																																																																																																																																																																																																																																																
7	CONTAMINATION SENSOR																																																																																																																																																																																																																																																																																
71-72	36	ADC Channel 1																																																																																																																																																																																																																																																																															
73-74	37	ADC Channel 2																																																																																																																																																																																																																																																																															
75-76	38	ADC Channel 3																																																																																																																																																																																																																																																																															
77-78	39	ADC Channel 4																																																																																																																																																																																																																																																																															
79-80	40	ADC Channel 5																																																																																																																																																																																																																																																																															
81-82	41	ADC Channel 6																																																																																																																																																																																																																																																																															
83-84	42	ADC Channel 7																																																																																																																																																																																																																																																																															
85-86	43	Error Status Word	<p>Contains the long word containing the bit flags for the CY? Command. The ESW is cleared (set to zero) between each ensemble.</p> <p>Note that each number above represents one bit set – they may occur in combinations. For example, if the long word value is 0000C000 (hexadecimal), then it indicates that <u>both</u> a cold wake-up (0004000) and an unknown wake-up (00008000) occurred.</p> <p>Low 16 BITS LSB</p> <table><tr><th>BITS</th><th>07</th><th>06</th><th>05</th><th>04</th><th>03</th><th>02</th><th>01</th><th>00</th><th></th></tr><tr><td></td><td>x</td><td>x</td><td>x</td><td>x</td><td>x</td><td>x</td><td>x</td><td>1</td><td>Bus Error exception</td></tr><tr><td></td><td>x</td><td>x</td><td>x</td><td>x</td><td>x</td><td>x</td><td>1</td><td>x</td><td>Address Error exception</td></tr><tr><td></td><td>x</td><td>x</td><td>x</td><td>x</td><td>x</td><td>1</td><td>x</td><td>x</td><td>Illegal Instruction exception</td></tr><tr><td></td><td>x</td><td>x</td><td>x</td><td>x</td><td>1</td><td>x</td><td>x</td><td>x</td><td>Zero Divide exception</td></tr><tr><td></td><td>x</td><td>x</td><td>x</td><td>1</td><td>x</td><td>x</td><td>x</td><td>x</td><td>Emulator exception</td></tr><tr><td></td><td>x</td><td>x</td><td>1</td><td>x</td><td>x</td><td>x</td><td>x</td><td>x</td><td>Unassigned exception</td></tr><tr><td></td><td>x</td><td>1</td><td>x</td><td>x</td><td>x</td><td>x</td><td>x</td><td>x</td><td>Watchdog restart occurred</td></tr><tr><td></td><td>1</td><td>x</td><td>x</td><td>x</td><td>x</td><td>x</td><td>x</td><td>x</td><td>Battery Saver power</td></tr></table> <p>Low 16 BITS MSB</p> <table><tr><th>BITS</th><th>15</th><th>14</th><th>13</th><th>12</th><th>11</th><th>10</th><th>09</th><th>08</th><th></th></tr><tr><td></td><td>x</td><td>x</td><td>x</td><td>x</td><td>x</td><td>x</td><td>x</td><td>1</td><td>Pinging</td></tr><tr><td></td><td>x</td><td>x</td><td>x</td><td>x</td><td>x</td><td>x</td><td>1</td><td>x</td><td>Not Used</td></tr><tr><td></td><td>x</td><td>x</td><td>x</td><td>x</td><td>x</td><td>1</td><td>x</td><td>x</td><td>Not Used</td></tr><tr><td></td><td>x</td><td>x</td><td>x</td><td>x</td><td>1</td><td>x</td><td>x</td><td>x</td><td>Not Used</td></tr><tr><td></td><td>x</td><td>x</td><td>x</td><td>1</td><td>x</td><td>x</td><td>x</td><td>x</td><td>Not Used</td></tr><tr><td></td><td>x</td><td>x</td><td>1</td><td>x</td><td>x</td><td>x</td><td>x</td><td>x</td><td>Not Used</td></tr><tr><td></td><td>x</td><td>1</td><td>x</td><td>x</td><td>x</td><td>x</td><td>x</td><td>x</td><td>Cold Wakeup occurred</td></tr><tr><td></td><td>1</td><td>x</td><td>x</td><td>x</td><td>x</td><td>x</td><td>x</td><td>x</td><td>Unknown Wakeup occurred</td></tr></table> <p>High 16 BITS LSB</p> <table><tr><th>BITS</th><th>24</th><th>23</th><th>22</th><th>21</th><th>20</th><th>19</th><th>18</th><th>17</th><th></th></tr><tr><td></td><td>x</td><td>x</td><td>x</td><td>x</td><td>x</td><td>x</td><td>x</td><td>1</td><td>Clock Read error occurred</td></tr><tr><td></td><td>x</td><td>x</td><td>x</td><td>x</td><td>x</td><td>x</td><td>1</td><td>x</td><td>Unexpected alarm</td></tr><tr><td></td><td>x</td><td>x</td><td>x</td><td>x</td><td>x</td><td>1</td><td>x</td><td>x</td><td>Clock jump forward</td></tr><tr><td></td><td>x</td><td>x</td><td>x</td><td>x</td><td>1</td><td>x</td><td>x</td><td>x</td><td>Clock jump backward</td></tr><tr><td></td><td>x</td><td>x</td><td>x</td><td>1</td><td>x</td><td>x</td><td>x</td><td>x</td><td>Not Used</td></tr><tr><td></td><td>x</td><td>x</td><td>1</td><td>x</td><td>x</td><td>x</td><td>x</td><td>x</td><td>Not Used</td></tr><tr><td></td><td>x</td><td>1</td><td>x</td><td>x</td><td>x</td><td>x</td><td>x</td><td>x</td><td>Not Used</td></tr><tr><td></td><td>1</td><td>x</td><td>x</td><td>x</td><td>x</td><td>x</td><td>x</td><td>x</td><td>Not Used</td></tr></table>	BITS	07	06	05	04	03	02	01	00			x	x	x	x	x	x	x	1	Bus Error exception		x	x	x	x	x	x	1	x	Address Error exception		x	x	x	x	x	1	x	x	Illegal Instruction exception		x	x	x	x	1	x	x	x	Zero Divide exception		x	x	x	1	x	x	x	x	Emulator exception		x	x	1	x	x	x	x	x	Unassigned exception		x	1	x	x	x	x	x	x	Watchdog restart occurred		1	x	x	x	x	x	x	x	Battery Saver power	BITS	15	14	13	12	11	10	09	08			x	x	x	x	x	x	x	1	Pinging		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	Cold Wakeup occurred		1	x	x	x	x	x	x	x	Unknown Wakeup occurred	BITS	24	23	22	21	20	19	18	17			x	x	x	x	x	x	x	1	Clock Read error occurred		x	x	x	x	x	x	1	x	Unexpected alarm		x	x	x	x	x	1	x	x	Clock jump forward		x	x	x	x	1	x	x	x	Clock jump backward		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
BITS	07	06	05	04	03	02	01	00																																																																																																																																																																																																																																																																									
	x	x	x	x	x	x	x	1	Bus Error exception																																																																																																																																																																																																																																																																								
	x	x	x	x	x	x	1	x	Address Error exception																																																																																																																																																																																																																																																																								
	x	x	x	x	x	1	x	x	Illegal Instruction exception																																																																																																																																																																																																																																																																								
	x	x	x	x	1	x	x	x	Zero Divide exception																																																																																																																																																																																																																																																																								
	x	x	x	1	x	x	x	x	Emulator exception																																																																																																																																																																																																																																																																								
	x	x	1	x	x	x	x	x	Unassigned exception																																																																																																																																																																																																																																																																								
	x	1	x	x	x	x	x	x	Watchdog restart occurred																																																																																																																																																																																																																																																																								
	1	x	x	x	x	x	x	x	Battery Saver power																																																																																																																																																																																																																																																																								
BITS	15	14	13	12	11	10	09	08																																																																																																																																																																																																																																																																									
	x	x	x	x	x	x	x	1	Pinging																																																																																																																																																																																																																																																																								
	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	Cold Wakeup occurred																																																																																																																																																																																																																																																																								
	1	x	x	x	x	x	x	x	Unknown Wakeup occurred																																																																																																																																																																																																																																																																								
BITS	24	23	22	21	20	19	18	17																																																																																																																																																																																																																																																																									
	x	x	x	x	x	x	x	1	Clock Read error occurred																																																																																																																																																																																																																																																																								
	x	x	x	x	x	x	1	x	Unexpected alarm																																																																																																																																																																																																																																																																								
	x	x	x	x	x	1	x	x	Clock jump forward																																																																																																																																																																																																																																																																								
	x	x	x	x	1	x	x	x	Clock jump backward																																																																																																																																																																																																																																																																								
	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																																																																																																																																																																																																																																																																								
87-88	44																																																																																																																																																																																																																																																																																
89-90	45																																																																																																																																																																																																																																																																																

Table 45: Variable Leader Data Format (continued)

Hex Digit	Binary Byte	Field	Description
91-92	46		High 16 BITS MSB BITS 32 31 30 29 28 27 26 25 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 Power Fail (Unrecorded) x x x 1 x x x x Spurious level 4 intr (DSP) x x 1 x x x x x Spurious level 5 intr (UART) x 1 x x x x x x Spurious level 6 intr (CLOCK) 1 x x x x x x x Level 7 interrupt occurred
93-96	47-48	Reserved	Reserved for TRDI use.
97-104	49-52	Pressure	Contains the pressure of the water at the transducer head relative to one atmosphere (sea level). Output is in deca-pascals (see How Does the H-ADCP Sample Depth and Pressure?). Scaling: LSD=1 deca-pascal; Range=0 to 4,294,967,295 deca-pascals
105-112	53-56	Pressure variance	Contains the variance (deviation about the mean) of the pressure sensor data. Output is in deca-pascals. Scaling: LSD=1 deca-pascal; Range=0 to 4,294,967,295 deca-pascals
113-114	57	Spare	Spare
115-116	58	RTC Century	These fields contain the time from the H-ADCP's Y2K compliant real-time clock (RTC) that the current data ensemble began. The TT-command (Set Real-Time Clock) initially sets the clock. The H-ADCP <u>does</u> account for leap years.
117-118	59	RTC Year	
119-120	60	RTC Month	
121-122	61	RTC Day	
123-124	62	RTC Hour	
125-126	63	RTC Minute	
127-128	64	RTC Seconds	
129-130	65	RTC Hundredths	

How Does the H-ADCP Sample Depth and Pressure?

- a. For each ping, the ADC samples the pressure sensor five times and averages the data. This is an attempt to reduce the Standard Deviation.
- b. Using the Pressure coefficients, the pressure data from the ADC is converted to kPa.
- c. That data is converted to dm and corrected for salinity with the following equation:

Depth (dm) = Pressure(kPa) * (1.02-0.00069*ES), where ES is the Salinity setting.

This is the depth value recorded in the PD0 variable leader when the H-ADCP is fitted with a pressure sensor and that the EZ command is set to EZx1xxxxx.

- d. The pressure data is converted from kPa to deca-Pascals by multiplying it by 100. This value in deca Pascals is recorded in the PD0 variable leader data.

Converting kpa to Depth

The formula for converting kpa to depth (using *WinADCP*) is as follows:

$$(\text{kpa}(1.02-0.00069*\text{Salinity}))*(1000/\text{Water Density})/10$$

13.4 Velocity Data Format

BYTE	BIT POSITIONS								
	7/S	6	5	4	3	2	1	0	
1	VELOCITY ID								LSB 00h
2									MSB 01h
3	DEPTH CELL #1, VELOCITY 1								LSB
4									MSB
5	DEPTH CELL #1, VELOCITY 2								LSB
6									MSB
7	DEPTH CELL #1, VELOCITY 3								LSB
8									MSB
9	DEPTH CELL #1, VELOCITY 4								LSB
10									MSB
11	DEPTH CELL #2, VELOCITY 1								LSB
12									MSB
13	DEPTH CELL #2, VELOCITY 2								LSB
14									MSB
15	DEPTH CELL #2, VELOCITY 3								LSB
16									MSB
17	DEPTH CELL #2, VELOCITY 4								LSB
18									MSB
↓	(SEQUENCE CONTINUES FOR UP TO 128 CELLS)								↓
1019	DEPTH CELL #128, VELOCITY 1								LSB
1020									MSB
1021	DEPTH CELL #128, VELOCITY 2								LSB
1022									MSB
1023	DEPTH CELL #128, VELOCITY 3								LSB
1024									MSB
1025	DEPTH CELL #128, VELOCITY 4								LSB
1026									MSB

See Table 46 for description of fields

Figure 43. Velocity Data Format



NOTE. The number of depth cells is set by the WN-command.

The H-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 H-ADCP scales velocity data in millimeters per second (mm/s). A value of -32768 (8000h) indicates bad velocity values.

All velocities are relative based on a stationary instrument. To obtain absolute velocities, algebraically remove the velocity of the instrument. For example,

```
RELATIVE WATER CURRENT VELOCITY:    EAST 650 mm/s
INSTRUMENT VELOCITY                 : (-) EAST 600 mm/s
ABSOLUTE WATER VELOCITY              :    EAST 50 mm/s
```

The setting of the EX-command (Coordinate Transformation) determines how the H-ADCP references the velocity data as shown below.

EX-CMD	COORD SYS	VEL 1	VEL 2	VEL 3	VEL 4
EX00xxx	BEAM	TO BEAM 1	TO BEAM 2	TO BEAM 3	0
EX01xxx	INST	X AXIS	Y AXIS	0	ERROR VEL
EX10xxx	SHIP	X AXIS	Y AXIS	VERTICAL	ERROR VEL (tilt applied)
EX11xxx	EARTH	EAST	NORTH	VERTICAL	ERROR VEL (heading applied)

POSITIVE VALUES INDICATE WATER MOVEMENT TOWARD THE H-ADCP

Table 46: Velocity Data Format


Hex Digit	Binary Byte	Field	Description
1-4	1,2	Velocity ID	Stores the velocity data identification word (00 01h).
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.

13.5 Correlation Magnitude, Echo Intensity, and Percent-Good Data Format

BYTE	BIT POSITIONS								
	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	RESERVED								
7	DEPTH CELL #2, FIELD #1								
8	DEPTH CELL #2, FIELD #2								
9	DEPTH CELL #2, FIELD #3								
10	RESERVED								
↓	(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	RESERVED								

See Table 47 through Table 49 for a description of the fields.

Figure 44. Binary Correlation Magnitude, Echo Intensity, and Percent-Good Data Format

**NOTE.** The number of depth cells is set by the WN-command.

Correlation magnitude data give the magnitude of the normalized echo autocorrelation at the lag used for estimating the Doppler phase change. The H-ADCP represents this magnitude by a linear scale between 0 and 255, where 255 is perfect correlation (i.e., a solid target). A value of zero indicates bad correlation values.

Table 47: Correlation Magnitude Data Format

Hex Digit	Binary Byte	Field	Description
1-4	1,2	ID Code	Stores the correlation magnitude data identification word (00 02h).
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	RESERVED	RESERVED
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 three 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 H-ADCP count. The H-ADCP does not directly check for the validity of echo intensity data.

Table 48: Echo Intensity Data Format

Hex Digit	Binary Byte	Field	Description
1 – 4	1,2	ID Code	Stores the echo intensity data identification word (00 03h).
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	RESERVED	RESERVED
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 three 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 H-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:					
xxx00xxx	Beam	Beam 1	Beam 2	Beam 3	RESERVED
Percentage Of:					
xxx01xxx	Inst	Field 1	Field 2	Field 3	Field 4
xxx10xxx	Ship	Partial Solution Transformation	Transformations Rejected (note 2)	No Solution Available in Bin	Full Solution Transformations
xxx11xxx	Earth	(note 1)			

1. Because profile data did not exceed correlation threshold (WC).
2. Because the error velocity threshold (WE) was exceeded.

At the start of the velocity profile, the backscatter echo strength is typically high on all three beams. Under this condition, the H-ADCP uses all three 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 H-ADCP to reject some of its depth cell data. This causes the H-ADCP to calculate velocities with two beams instead of three beams. When the H-ADCP does 2-beam solutions, it stops calculating the error velocity because it needs three beams to do this. At some further depth cell, the H-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 = 50, FIELD #4 = 0



NOTE. The H-ADCP is very similar to the standard WorkHorse ADCP with four vertical beams. The H-ADCP measures X and Y velocities on the Horizontal instead of X, Y, and Z on the Vertical. The third beam on the H-ADCP provides the error velocity and acts in the same way as the fourth beam on a vertical system.

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% and Beam 3=50%. These are neither typical nor desired percentages. Typically, you would want all beams to be about equal and greater than 25%.

On the other hand, if velocities were collected in INSTRUMENT coordinates and bin 60 returned the following percent-good, the results would be interpreted differently.

FIELD #1 = 50, FIELD #2 = 5, FIELD #3 = 45, FIELD #4 = 0

FIELD 1 - Percentage of Partial Solutions - Shows percentage of successful velocity calculations (50%) resulting in Partial Solutions. A Partial Solution is a solution that does not result in an error velocity. This occurs because there is not enough information to compute the error velocity.

FIELD 2 - Percentage of transformations rejected - Shows percent of error velocity (5%) that was less than the WE-command setting. The WE command has a default of 5000 mm/s. This large WE setting effectively prevents the H-ADCP from rejecting data based on error velocity.

FIELD 3 - Percentage of No Solution Transformations - 45% of the velocity data were rejected because there was insufficient information (velocity Data) to attempt a transformation.

FIELD 4 - Percentage of Full Solutions - 0% of the velocity data collected during the ensemble for range cell 60 generated a Full Solution. A Full Solution indicates that an error velocity is available.

Table 49: Percent-Good Data Format

Hex Digit	Binary Byte	Field	Description
1-4	1,2	ID Code	Stores the percent-good data identification word (00 04h).
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.

13.6 Binary Bottom-Track Data Format

BIT POSITIONS									
BYTE	7/S	6	5	4	3	2	1	0	
1	BOTTOM-TRACK ID								LSB 00h
2									MSB 06h
3	BT PINGS PER ENSEMBLE {BP}								LSB
4									MSB
5	BT DELAY BEFORE RE-ACQUIRE {BD}								LSB
6									MSB
7	BT CORR MAG MIN {BC}								
8	BT EVAL AMP MIN {BA}								
9	BT PERCENT GOOD MIN {BG}								
10	BT MODE {BM}								
11	BT ERR VEL MAX {BE}								LSB
12									MSB
13	RESERVED								
14									
15									
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	RESERVED								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	RESERVED								LSB
32									MSB

Continued Next Page

Continued from Previous Page

33	BEAM#1 BT CORR.	
34	BEAM#2 BT CORR.	
35	BEAM#3 BT CORR.	
36	RESERVED	
37	BEAM#1 EVAL AMP	
38	BEAM#2 EVAL AMP	
39	BEAM#3 EVAL AMP	
40	RESERVED	
41	BEAM#1 BT %GOOD	
42	BEAM#2 BT %GOOD	
43	BEAM#3 BT %GOOD	
44	RESERVED	
45	REF LAYER MIN {BL}	LSB
46		MSB
47	REF LAYER NEAR {BL}	LSB
48		MSB
49	REF LAYER FAR {BL}	LSB
50		MSB
51	BEAM#1 REF LAYER VEL	LSB
52		MSB
53	BEAM #2 REF LAYER VEL	LSB
54		MSB
55	BEAM #3 REF LAYER VEL	LSB
56		MSB
57	RESERVED	LSB
58		MSB
59	BM#1 REF CORR	
60	BM#2 REF CORR	
61	BM#3 REF CORR	
62	RESERVED	
63	BM#1 REF INT	
64	BM#2 REF INT	
65	BM#3 REF INT	
66	RESERVED	

Continued Next Page

Continued from Previous Page

67	BM#1 REF %GOOD	
68	BM#2 REF %GOOD	
69	BM#3 REF %GOOD	
70	RESERVED	
71	BT MAX. DEPTH {BX}	LSB
72		MSB
73	BM#1 RSSI AMP	
74	BM#2 RSSI AMP	
75	BM#3 RSSI AMP	
76	RESERVED	
77	GAIN	
78	(*SEE BYTE 17)	MSB
79	(*SEE BYTE 19)	MSB
80	(*SEE BYTE 21)	MSB
81	(*SEE BYTE 23)	MSB
82	RESERVED	
83		
84		
85		

Figure 45. Binary Bottom-Track Data Format

NOTE. This data is output only if the BP-command is > 0 and PD0 is selected. See Table 50 for a description of the fields.



NOTE. The PD0 output data format assumes that the **instrument** is stationary and the **bottom** is moving. DVL (Speed Log) output data formats (see [Special Output Data Formats](#)) assume that the bottom is stationary and that the H-ADCP or vessel is moving.

This data is output only if the BP-command is greater than zero and PD0 is selected. The LSB is always sent first.

Table 50: Bottom-Track Data Format

Hex Digit	Binary Byte	Field	Description
1-4	1,2	ID Code	Stores the bottom-track data identification word (00 06h).
5-8	3,4	BP/BT Pings per ensemble	Stores the number of bottom-track pings to average together in each ensemble (BP-command). If BP = 0, the H-ADCP does not collect bottom-track data. The H-ADCP automatically extends the ensemble interval (TE) if BP x TP > TE. Scaling: LSD = 1 ping; Range = 0 to 999 pings
9-12	5,6	BD/BT delay before reacquire	Stores the number of H-ADCP ensembles to wait after losing the bottom before trying to reacquire it (BD-command). Scaling: LSD = 1 ensemble; Range = 0 to 999 ensembles
13,14	7	BC/BT Corr Mag Min	Stores the minimum correlation magnitude value (BC-command). Scaling: LSD = 1 count; Range = 0 to 255 counts
15,16	8	BA/BT Eval Amp Min	Stores the minimum evaluation amplitude value (BA-command). Scaling: LSD = 1 count; Range = 1 to 255 counts
17,18	9	BG/BT %Gd Minimum	Stores the minimum percentage of bottom-track pings in an ensemble that must be good to output velocity data (BG-command).
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-command). 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 #1-3 BT Range	Contains the two lower bytes of the vertical range from the H-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 #1-3 BT Vel	The meaning of the velocity depends on the EX (coordinate system) command setting. 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: Starboard, Fwd, Upward, Error d) Earth Coordinates: East, North, Upward, Error
65-72	33-36	BTCM/Beam #1-3 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 (Table 5).

Continued Next Page

Table 50: Bottom-Track Data Format (continued)

Hex Digit	Binary Byte	Field	Description
73-80	37-40	BTEA/Beam #1-3 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	BTPG/Beam #1-3 BT %Good	Contains bottom-track percent-good data for each beam, which indicate the reliability of bottom-track data. It is the percentage of bottom-track pings that have passed the H-ADCP's bottom-track validity algorithm during an ensemble. Scaling: LSD = 1 percent; Range = 0 to 100 percent
89-92 93-96 97 – 100	45,46 47,48 49,50	Ref Layer (Min, Near, Far)	Stores the minimum layer size, the near boundary, and the far boundary of the BT water-reference layer (BL-command). Scaling (minimum layer size): LSD = 1 dm; Range = 0-999 dm Scaling (near/far boundaries): LSD = 1 dm; Range = 0-9999 dm
101- 116	51-58	Ref Vel/Beam #1-4 Ref Layer Vel	Contains velocity data for the water reference layer for each beam. Reference layer velocities have the same format and scale factor as water-profiling velocities (Table 46). The BL-command explains the water reference layer.
117- 124	59-62	RLCM/Bm #1-3 Ref Corr	Contains correlation magnitude data for the water reference layer for each beam. Reference layer correlation magnitudes have the same format and scale factor as water-profiling magnitudes (Table 5).
125- 132	63-66	RLEI/Bm #1-3 Ref Int	Contains echo intensity data for the reference layer for each beam. Reference layer intensities have the same format and scale factor as water-profiling intensities.
133- 140	67-70	RLPG/Bm #1-3 Ref %Good	Contains percent-good data for the water reference layer for each beam. They indicate the reliability of reference layer data. It is the percentage of bottom-track pings that have passed a reference layer validity algorithm during an ensemble. Scaling: LSD = 1 percent; Range = 0 to 100 percent
141- 144	71,72	BX/BT Max. Depth	Stores the maximum tracking depth value (BX-command). Scaling: LSD = 1 decimeter; Range = 80 to 9999 decimeters
145-152	73-76	RSSI/Bm #1-3 RSSI Amp	Contains the Receiver Signal Strength Indicator (RSSI) value in the center of the bottom echo as determined by each beam. Scaling: LSD \approx 0.45 dB per count; Range = 0 to 255 counts
153, 154	77	GAIN	Contains the Gain level for shallow water. See WJ-command.
155-162	78-81	BT Range MSB/Bm #1-3	Contains the most significant byte of the vertical range from the H-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
163-170	82-85	Reserved	Reserved

13.7 Binary Reserved BIT Data Format

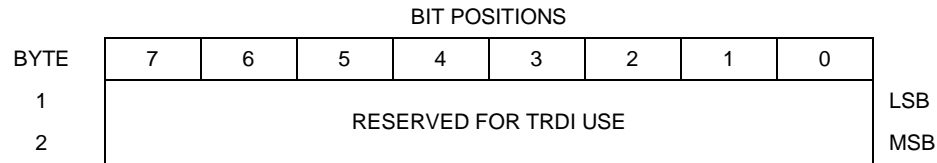


Figure 46. Binary Reserved BIT Data Format



NOTE. The data is always output in this format. See Table 51 for a description of the fields.

Table 51: Reserved for TRDI Format

Hex Digit	Binary Byte	Field	Description
1-4	1,2	Reserved for TRDI's use	This field is for TRDI (internal use only).

13.8 Binary Checksum Data Format

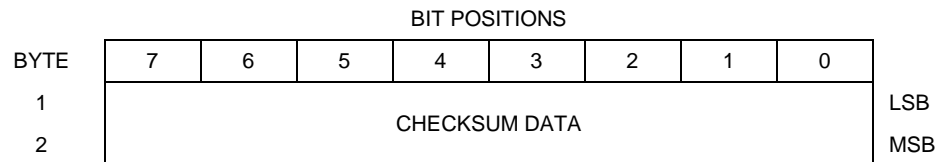


Figure 47. Binary Checksum Data Format



NOTE. The data is always output in this format. See Table 52 for a description of the fields.

Table 52: Checksum Data Format

Hex Digit	Binary Byte	Field	Description
1-4	1,2	Checksum Data	This field contains a modulo 65535 checksum. The H-ADCP computes the checksum by summing all the bytes in the output buffer excluding the checksum.

14 Special Output Data Formats

The PD3, PD4, PD5, and PD6 commands select the desired DVL (speed log) output data format. PD8 is a special ASCII output data format. PD14 is a condensed 2D output format for H-ADCPs only.

The DVL binary output data buffers can contain header, configuration, bottom-velocity, water-mass reference-layer, range to bottom, status, built-in test, sensor, and distance made good data (plus a checksum). The H-ADCP collects all data in the output buffer during an ensemble.

Figure 48 through Figure 50 shows the format of these buffers and the sequence in which the H-ADCP sends the data. Table 53 through Table 55 list the format, bytes, fields, scaling factors, and a detailed description of every item in the DVL binary output buffers.



NOTE. The DVL output data formats are available with or without bottom-track. However, if bottom-track is not available, they will contain no data.



NOTE. The DVL output data formats assume that the bottom is stationary and that the H-ADCP or vessel is moving. The PD0 Bottom Track output data format (see [Binary Bottom-Track Data Format](#)) assumes that the instrument is stationary and the bottom is moving.

14.1 DVL Binary Data Format (PD3)

BIT POSITION										
Byte	7	6	5	4	3	2	1	0		
1	DVL DATA ID 7Eh									
2	DATA STRUCTURE*									
3	STARBOARD/EAST VELOCITY (With Respect To BTM)								LSB	
4									MSB	
5	FORWARD/NORTH VELOCITY (With Respect To BTM)								LSB	
6									MSB	
7	UPWARD VELOCITY (With Respect To BTM)								LSB	
8									MSB	
9	STARBOARD/EAST VELOCITY (With Respect To WATER REF)								LSB	
10									MSB	
11	FORWARD/NORTH VELOCITY (With Respect To WATER REF)								LSB	
12									MSB	
13	UPWARD VELOCITY (With Respect To WATER REF)								LSB	
14									MSB	
15	BM1 RNG TO BTM								LSB	
16									MSB	
17	BM2 RNG TO BTM								LSB	
18									MSB	
19	BM3 RNG TO BTM								LSB	
20									MSB	
21	BM4 RNG TO BTM								LSB	
22									MSB	
23	RANGE TO BTM (AVERAGE)								LSB	
24									MSB	
25	SPARE									
↓										↓
↓										↓
40										

Continued next page

Continued from Previous Page

41	SENSOR/OTHER DATA	
42	PING TIME: HOUR	
43	MINUTE	
44	SECOND	
45	HUNDREDTH	
46	HEADING	LSB
47		MSB
48	PITCH	LSB
49		MSB
50	ROLL	LSB
51		MSB
52	TEMPERATURE	LSB
53		MSB
54	BIT RESULTS	LSB
55		MSB
56	CHECKSUM	LSB
57		MSB

Figure 48. DVL Binary Data Format (PD3)

14.2 DVL Output Data Format (PD3) Details

The H-ADCP sends this data format only when the PD3 command is used. In multiple byte parameters, the least significant byte always comes before the more significant bytes.

Table 53: DVL Output Data Format (PD3) Details

Hex Digit	Binary Byte	Field	Description
1,2	1	DVL Data ID	Stores the DVL (speed log) identification word (7Eh)
3,4	2	Reserved	Reserved
5-8	3,4	X-Vel Btm	† Bit #0: Always output. If the data bit is set to 0, then Ship coordinates are used. If the data bit is set to 1, then Earth coordinates are used. These fields contain the velocity of the vessel in relation to the bottom in mm/s. Positive values indicate vessel motion to (X) Starboard/East, (Y) Forward/North, (Z) Upward.
9-12	5,6	Y-Vel Btm	
13-16	7,8	Z-Vel Btm	† Bit #1: Vertical velocities.
17-20	9,10	X-Vel Water	† Bit #2: These fields contain the velocity of the vessel in relation to the water reference layer in mm/s. Positive values indicate vessel motion to (X) Starboard/East, (Y) Forward/North, (Z) Upward.
21-24	11,12	Y-Vel Water	
25-28	13,14	Z-Vel Water	† Bit #1 and Bit #2
29-32	15,16	Bm1	† Bit #3: These fields contain the vertical range from the H-ADCP to the bottom as determined by each beam. This vertical range does not compensate for the effects of pitch and roll. When a bottom detection is bad, the field is set to zero.
33-36	17,18	Bm2 Rng to	
37-40	19,20	Bm3 Bottom	
41-44	21,22	Bm4	Scaling: LSD = 1 centimeter; Range = 0 to 65535 cm
45-48	23,24	Avg Rng to Btm	† Bit #4: These fields contain the average vertical range from the H-ADCP to the bottom as determined by each beam.

Continued next page

Table 53: DVL Output Data Format (PD3) Details (continued)

Hex Digit	Binary Byte	Field	Description
49-80	25-40	Spare	Spare
81,82	41	Sensor/Other Data	† Output if Bit #7 of "Data to Follow" byte is set. These fields contain the Sensor/Other data. Bit # 0 = Time 1 = Heading 2 = Pitch 3 = Roll 4 = Temperature 5 = Active Built-In-Test
83-90	42,43	Time: HH,MM	‡ Sensor/Other Data Bit #0: These fields contains the time of the ping in Hours, Minutes Seconds, Hundredths of seconds respectively.
	44,45	Time: SS,HH	
91-94	46,47	Heading	‡ Sensor/Other Data Bit #1: this field contains the Heading in hundredths of degrees.
95-98	48,49	Pitch	‡ Sensor/Other Data Bit #2: this field contains the Pitch in hundredths of degrees.
99-102	50,51	Roll	‡ Sensor/Other Data Bit #3: this field contains the Roll in hundredths of degrees.
103-106	52,53	Temp	‡ Sensor/Other Data Bit #4: this field contains the Temperature in hundredths of degrees.
107-110	54,55	BIT results	‡ Sensor/Other Data Bit #5: this field contains the Built-In-Test results. Each bit specifies the result of built-in-test during an ensemble. If the bit is set, the test failed. BYTE 54 BYTE 55 (BYTE 55 RESERVED FOR FUTURE USE) 1xxxxxxx xxxxxxxx = RESERVED x1xxxxxx xxxxxxxx = RESERVED xx1xxxxx xxxxxxxx = RESERVED xxx1xxxx xxxxxxxx = DEMOD 1 ERROR xxxx1xxx xxxxxxxx = DEMOD 0 ERROR xxxxx1xx xxxxxxxx = RESERVED xxxxxx1x xxxxxxxx = DSP ERROR xxxxxxx1 xxxxxxxx = RESERVED
111-114	56,57	Checksum	This is the 16-bit checksum of all the preceding binary bytes.

NOTES.

- † This block of data is only output if the bit is set in the Data to Follow byte.
‡ This block of data is only output if the bit is set in the Sensor/Other Data byte.

14.3 DVL Binary Data Format (PD4/PD5)

Byte	BIT POSITION								
	7	6	5	4	3	2	1	0	
1	DVL DATA ID 7Dh								
2	DATA STRUCTURE*								
3	NO. OF BYTES								LSB
4									MSB
5	SYSTEM CONFIG								
6	X-VEL BTM								LSB
7									MSB
8	Y-VEL BTM								LSB
9									MSB
10	Z-VEL BTM								LSB
11									MSB
12	E-VEL BTM								LSB
13									MSB
14	BM1 RNG TO BTM								LSB
15									MSB
16	BM2 RNG TO BTM								LSB
17									MSB
18	BM3 RNG TO BTM								LSB
19									MSB
20	BM4 RNG TO BTM								LSB
21									MSB
22	BOTTOM STATUS								
23	X-VEL REF LAYER								LSB
24									MSB
25	Y-VEL REF LAYER								
26									
27	Z-VEL REF LAYER								
28									

Continued Next Page

Continued from Previous Page

29	E-VEL REF LAYER
30	
31	REF LAYER START
32	
33	REF LAYER END
34	
35	REF LAYER STATUS
36	TOFP-HOUR
37	TOFP-MINUTE
38	TOFP-SECOND
39	TOFP-HUNDREDTHS
40	BIT RESULTS
41	
42	SPEED OF SOUND
43	
44	TEMPERATURE
45	
46	CHECKSUM
47	

Figure 49. DVL Binary Data Format (PD4/PD5)



NOTES.

*If 0, then PD4 (Bytes 1-47)

*If 1, then PD5 (Bytes 1-45 + Table 55)

14.4 DVL Output Data Format (PD4/PD5) Details

The H-ADCP sends this data format only when the PD4 or PD5 command is used.

Table 54: DVL Output Data Format (PD4/PD5) Details

Hex Digit	Binary Byte	Field	Description
1,2	1	DVL Data ID	Stores the DVL (speed log) identification word (7Dh).
3,4	2	Data Structure	Identifies which data pattern will follow based on the PD-command. 0 = PD4 = Bytes 1 through 47 from Figure 49. 1 = PD5 = Bytes 1 through 45 from Figure 49 and bytes 46 through 88 from Figure 50. Note: PD6 is ASCII-only; see Table 56.
5-8	3,4	No. of Bytes	Contains the number of bytes sent in this data structure, not including the final checksum.
9,10	5	System Config	Defines the DVL hardware/firmware configuration. Convert to binary and interpret as follows. BIT 76543210 00xxxxxx BEAM-COORDINATE VELOCITIES 01xxxxxx INSTRUMENT-COORDINATE VELOCITIES 10xxxxxx SHIP-COORDINATE VELOCITIES 11xxxxxx EARTH-COORDINATE VELOCITIES xx0xxxxx TILT INFORMATION NOT USED IN CALCULATIONS xx1xxxxx TILT INFORMATION USED IN CALCULATIONS xxx0xxxx 3-BEAM SOLUTIONS NOT COMPUTED xxx1xxxx 3-BEAM SOLUTIONS COMPUTED xxxxx010 300-kHz DVL xxxxx011 600-kHz DVL xxxxx100 1200-kHz DVL
11-14	6,7	X-Vel Btm	These fields contain the velocity of the vessel in relation to the bottom in mm/s. Positive values indicate vessel motion to east (X), north (Y), and up (Z). LSD = 1 mm/s (see NOTES at end of this table).
15-18	8,9	Y-Vel Btm	
19-22	10,11	Z-Vel Btm	
23-26	12,13	E-Vel Btm	
27-30	14,15	Bm1	These fields contain the vertical range from the H-ADCP to the bottom as determined by each beam. This vertical range does not compensate for the effects of pitch and roll. When a bottom detection is bad, the field is set to zero. Scaling: LSD = 1 centimeter; Range = 0 to 65535 cm
31-34	16,17	Bm2 Rng to	
35-38	18,19	Bm3 Bottom	
39-42	20,21	Bm4	

Continued next page

Table 54: DVL Output Data Format (PD4/PD5) Details (continued)

Hex Digit	Binary Byte	Field	Description
43,44	22	Bottom Status	<p>This field shows the status of bottom-referenced correlation and echo amplitude data. Convert to binary and interpret as follows. A zero code indicates status is OK.</p> <p>BIT 76543210</p> <p>1xxxxxxx BEAM 4 LOW ECHO AMPLITUDE</p> <p>x1xxxxxx BEAM 4 LOW CORRELATION</p> <p>xx1xxxxx BEAM 3 LOW ECHO AMPLITUDE</p> <p>xxx1xxxx BEAM 3 LOW CORRELATION</p> <p>xxxx1xxx BEAM 2 LOW ECHO AMPLITUDE</p> <p>xxxxx1xx BEAM 2 LOW CORRELATION</p> <p>xxxxxx1x BEAM 1 LOW ECHO AMPLITUDE</p> <p>xxxxxxx1 BEAM 1 LOW CORRELATION</p>
45-48	23,24	X-Vel Ref Layer	<p>These fields contain the velocity of the vessel in relation to the water-mass reference layer in mm/s. Positive values indicate vessel motion to east (X), north (Y), and up (Z). LSD = 1 mm/s (See NOTES at end of this table.)</p>
49-52	25,26	Y-Vel Ref Layer	
53-56	27,28	Z-Vel Ref Layer	
57-60	29,30	E-Vel Ref Layer	
61-64	31,32	Ref Layer Start	<p>These fields contain the starting boundary (near surface) and the ending boundary (near bottom) of the water-mass reference layer (BL-command). If the minimum size field is zero, the H-ADCP does not calculate reference-layer data.</p> <p>Scaling: LSD = 1 dm; Range = 0-9999 dm</p>
65-68	33,34	Ref Layer End	
69,70	35	Ref Layer Status	<p>This field shows the status of reference layer depth and correlation data. Convert to binary and interpret as follows. A zero code indicates status is OK.</p> <p>BIT 76543210</p> <p>xxx1xxxx ALTITUDE IS TOO SHALLOW</p> <p>xxxx1xxx BEAM 4 LOW CORRELATION</p> <p>xxxxx1xx BEAM 3 LOW CORRELATION</p> <p>xxxxxx1x BEAM 2 LOW CORRELATION</p> <p>xxxxxxx1 BEAM 1 LOW CORRELATION</p>
71,72	36	TOFP Hour	<p>These fields contain the time of the first ping of the current ensemble.</p>
73,74	37	TOFP Minute	
75,76	38	TOFP Second	
77,78	39	TOFP Hundredth	
79-82	40,41	BIT Results	<p>These fields contain the results of the H-ADCP's Built-in Test function. A zero code indicates a successful BIT result.</p> <p>BYTE 40 BYTE 41 (BYTE 41 RESERVED FOR FUTURE USE)</p> <p>1xxxxxxx xxxxxxxx = RESERVED</p> <p>x1xxxxxx xxxxxxxx = RESERVED</p> <p>xx1xxxxx xxxxxxxx = RESERVED</p> <p>xxx1xxxx xxxxxxxx = DEMOD 1 ERROR</p> <p>xxxx1xxx xxxxxxxx = DEMOD 0 ERROR</p> <p>xxxxx1xx xxxxxxxx = RESERVED</p> <p>xxxxxx1x xxxxxxxx = DSP ERROR</p> <p>xxxxxxx1 xxxxxxxx = RESERVED</p>
83-86	42,43	Speed of Sound	<p>Contains either manual or calculated speed of sound information (EC-command).</p> <p>Scaling: LSD = 1 meter per second; Range = 1400 to 1600 m/s</p>
87-90	44,45	Temperature	<p>Contains the temperature of the water at the transducer head.</p> <p>Scaling: LSD = 0.01 C; Range = -5.00 to +40.00 C</p>

Table 54: DVL Output Data Format (PD4/PD5) Details (continued)

Hex Digit	Binary Byte	Field	Description
91-94	46,47	Checksum	This field contains a modulo 65536 checksum. The H-ADCP computes the checksum by summing all the bytes in the output buffer excluding the checksum. NOTE: This field contains the checksum only when the PD4-command is used. If PD5 is used, the remaining bytes are explained in Table 55.

NOTES.

The H-ADCP packs velocity data into a two-byte, two's-complement integer [-32768, 32767] with the LSB sent first. The H-ADCP scales velocity data in millimeters per second (mm/s). A value of -32768 (8000h) indicates a bad velocity.



Bottom or reference-layer velocities will be all valid or all invalid. That is, if the X-velocity is valid then the Y and Z-velocities are valid; if X is not valid, Y and Z are not valid.

The H-ADCP allows 3-beam transformations when the fourth beam is invalid. Indication of a 3-beam transformation for bottom-track is valid bottom velocities and one and only one beam's range to bottom is marked bad (zero).

There is no indication that a 3-beam transformation was performed for water reference layer velocity data.

14.5 DVL Binary Data Format (PD5)

Byte	BIT POSITION							
	7	6	5	4	3	2	1	0
46	SALINITY							
47	DEPTH							LSB
48								MSB
49	PITCH							LSB
50								MSB
51	ROLL							LSB
52								MSB
53	HEADING							LSB
54								MSB
55	DISTANCE MADE GOOD/BTM (EAST)							LSB
56								MSB
57								
58								MSB
59	DISTANCE MADE GOOD/BTM (NORTH)							LSB
60								MSB
61								
62								MSB
63	DISTANCE MADE GOOD/BTM (UP)							LSB
64								MSB
65								
66								MSB
67	DISTANCE MADE GOOD/BTM (ERROR)							LSB
68								MSB
69								
70								MSB
71	DISTANCE MADE GOOD/REF (EAST)							LSB
72								MSB
73								
74								MSB

Continued Next Page

Continued from Previous Page

75	DISTANCE MADE GOOD/REF (NORTH)	LSB
76		
77		
78		MSB
79	DISTANCE MADE GOOD/REF (UP)	LSB
80		
81		
82		MSB
83	DISTANCE MADE GOOD/REF (ERROR)	LSB
84		
85		
86		MSB
87	CHECKSUM	LSB
88		MSB

Figure 50. DVL Binary Data Format (PD5)

14.6 DVL Output Data Format (PD5) Details

The H-ADCP sends this data format (Figure 49 and Figure 50) only when the PD5 command is used. Table 54 explains the first part of this data structure.

Table 55: DVL Output Data Format (PD5) Details

Hex Digit	Binary Byte	Field	Description
91,92	46	Salinity	Contains the salinity value of the water at the transducer head (ES-command). This value may be a manual setting or a reading from a conductivity sensor. Scaling: LSD = 1 part per thousand; Range = 0 to 40 ppt
93-96	47,48	Depth	Contains the depth of the transducer below the water surface (ED-command). This value may be a manual setting or a reading from a depth sensor. Scaling: LSD = 1 decimeter; Range = 1 to 9999 decimeters
97-100	49,50	Pitch	Contains the H-ADCP pitch angle (EP-command). 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 = -20.00 to +20.00 degrees
101-104	51,52	Roll	Contains the H-ADCP roll angle (ER-command). This value may be a manual setting or a reading from a tilt sensor. For up-facing H-ADCPs, positive values mean that Beam #2 is spatially higher than Beam #1. For down-facing H-ADCPs, positive values mean that Beam #1 is spatially higher than Beam #2. Scaling: LSD = 0.01 degree; Range = -20.00 to +20.00 degrees
105-108	53,54	Heading	Contains the H-ADCP heading angle (EH-command). 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
109-116	55-58	DMG/Btm East	These fields contain the Distance Made Good (DMG) over the bottom since the time of the first ping after initialization or <BREAK>. Scaling: LSD = 1 dm; Range = -10,000,000 to 10,000,000 dm
117-124	59-62	DMG/Btm North	
125-132	63-66	DMG/Btm Up	
133-140	67-70	DMG/Btm Error	
141-148	71-74	DMG/Ref East	These fields contain the distance made good over the water-mass reference layer since the time of the first ping after initialization or <BREAK>. Scaling: LSD = 1 dm; Range = -10,000,000 to 10,000,000 dm
149-156	75-78	DMG/Ref North	
157-164	79-82	DMG/Ref Up	
165-172	83-86	DMG/Ref Error	
173-176	87,88	Checksum	This field contains a modulo 65536 checksum. The H-ADCP computes the checksum by summing all the bytes in the output buffer excluding the checksum.

14.7 DVL Output Data Format (PD6)

The H-ADCP sends this data format only when the PD6 command is used. The H-ADCP outputs data in the following line order. The H-ADCP may not sent all data lines. Examples: (1) If BK = zero, the H-ADCP does not send water-mass data (line items beginning with W); (2) If BK = three, the H-ADCP does not send bottom-track data (line items beginning with B).

Table 56: DVL Output Data Format (PD6)

Line	Description
1	SYSTEM ATTITUDE DATA :SA,±PP.PP,±RR.RR,HH.HH <CR><LF> where: PP.PP = Pitch in degrees RR.RR = Roll in degrees HHH.HH = Heading in degrees
2	TIMING AND SCALING DATA :TS,YYMMDDHHmmsssh,SS.S,±TT.T,DDDD.D,CCCC.C,BBB <CR><LF> where: YYMMDDHHmmsssh = Year, month, day, hour, minute, second, hundredths of seconds SS.S = Salinity in parts per thousand (ppt) TT.TT = Temperature in C DDDD.D = Depth of transducer face in meters CCCC.C = Speed of sound in meters per second BBB = Built-in Test (BIT) result code
3	WATER-MASS, INSTRUMENT-REFERENCED VELOCITY DATA :WI,±XXXXX,±YYYYY,±ZZZZZ,±EEEE,S <CR><LF> where: ±XXXXX = X-axis vel. data in mm/s (+ = Bm1 Bm2 xdcr movement relative to water mass) ±YYYYY = Y-axis vel. data in mm/s (+ = Bm4 Bm3 xdcr movement relative to water mass) ±ZZZZZ = Z-axis vel. data in mm/s (+ = transducer movement away from water mass) ±EEEE = Error velocity data in mm/s S = Status of velocity data (A = good, V = bad)
4	WATER-MASS, SHIP-REFERENCED VELOCITY DATA :WS,±TTTTT,±LLLLL,±NNNNN,S <CR><LF> where: ±TTTTT = Transverse vel. data in mm/s (+ = Port Stbd ship movement rel. to water mass) ±LLLLL = Longitudinal vel. data in mm/s (+ = Aft Fwd ship movement rel. to water mass) ±NNNNN = Normal velocity data in mm/s (+ = ship movement away from water mass) S = Status of velocity data (A = good, V = bad)
5	WATER-MASS, EARTH-REFERENCED VELOCITY DATA :WE,±EEEE,±NNNNN,±UUUUU,S <CR><LF> where: ±EEEE = East (u-axis) velocity data in mm/s (+ = H-ADCP movement to east) ±NNNNN = North (v-axis) velocity data in mm/s (+ = H-ADCP movement to north) ±UUUUU = Upward (w-axis) velocity data in mm/s (+ = H-ADCP movement to surface) S = Status of velocity data (A = good, V = bad)

Continued next page

Table 56: DVL Output Data Format (PD6) (continued)

Line	Description
6	WATER-MASS, EARTH-REFERENCED DISTANCE DATA :WD,±EEEEEEEE.EE,±NNNNNNNN.NN,±UUUUUUUU.UU,DDDD.DD,TTT.TT <CR><LF> where: +EEEEEEEE.EE = East (u-axis) distance data in meters +NNNNNNNN.NN = North (v-axis) distance data in meters +UUUUUUUU.UU = Upward (w-axis) distance data in meters DDDD.DD = Range to water-mass center in meters TTT.TT = Time since last good-velocity estimate in seconds
7	BOTTOM-TRACK, INSTRUMENT-REFERENCED VELOCITY DATA :BI,±XXXXX,±YYYYY,±ZZZZ,±EEEE,S <CR><LF> where: ±XXXXX = X-axis velocity data in mm/s (+ = Bm1 Bm2 xdcr movement relative to bottom) ±YYYYY = Y-axis velocity data in mm/s (+ = Bm4 Bm3 xdcr movement relative to bottom) ±ZZZZ = Z-axis velocity data in mm/s (+ = transducer movement away from bottom) ±EEEE = Error velocity data in mm/s S = Status of velocity data (A = good, V = bad)
8	BOTTOM-TRACK, SHIP-REFERENCED VELOCITY DATA :BS,±TTTTT,±LLLLL,±NNNNN,S <CR><LF> where: ±TTTTT = Transverse vel. data in mm/s (+ = Port Stbd ship movement relative to bottom) ±LLLLL = Longitudinal vel. data in mm/s (+ = Aft Fwd ship movement relative to bottom) ±NNNNN = Normal velocity data in mm/s (+ = ship movement away from bottom) S = Status of velocity data (A = good, V = bad)
9	BOTTOM-TRACK, EARTH-REFERENCED VELOCITY DATA :BE,±EEEE,±NNNNN,±UUUUU,S <CR><LF> where: ±EEEE = East (u-axis) velocity data in mm/s (+ = H-ADCP movement to east) ±NNNNN = North (v-axis) velocity data in mm/s (+ = H-ADCP movement to north) ±UUUUU = Upward (w-axis) velocity data in mm/s (+ = H-ADCP movement to surface) S = Status of velocity data (A = good, V = bad)
10	BOTTOM-TRACK, EARTH-REFERENCED DISTANCE DATA :BD,±EEEEEEEE.EE,±NNNNNNNN.NN,±UUUUUUUU.UU,DDDD.DD,TTT.TT <CR><LF> where: +EEEEEEEE.EE = East (u-axis) distance data in meters +NNNNNNNN.NN = North (v-axis) distance data in meters +UUUUUUUU.UU = Upward (w-axis) distance data in meters DDDD.DD = Range to bottom in meters TTT.TT = Time since last good-velocity estimate in seconds

The PD6 output does not pad spaces with zeroes. The spaces are left intact. The example below shows a realistic output from a H-ADCP locked onto the bottom.

```
:SA, -2.31, +1.92, 75.20
:TS,04081111563644,35.0,+21.0, 0.0,1524.0, 0
:WI,-32768,-32768,-32768,-32768,V
:BI, +24, -6, -20, -4,A
:WS,-32768,-32768,-32768,V
:BS, -13, +21, -20,A
:WE,-32768,-32768,-32768,V
:BE, +17, +18, -20,A
:WD, +0.00, +0.00, +0.00, 20.00, 0.00
:BD, -0.02, -0.03, +0.02, 7.13, 0.21
```

14.8 PD8 ASCII Output

The H-ADCP sends this data format only when the PD8 command is used. PD8 outputs ensemble data as formatted text. A new-line character terminates each line. Two new-line characters terminate an ensemble.

PD8 data is only for serial output. If you select PD8 and set the CF command to CFxxx01 (recorder on), the H-ADCP will output PD8 ASCII data out the serial port and record PD0 data to the recorder card. You can then use the PD0 data to troubleshoot any setup problems with the H-ADCP.

```
1997/02/28 11:16:50.07 00001
Hdg: 209.1 Pitch: 9.6 Roll: -9.1
Temp: 22.8 SoS: 1529 BIT: 00
Bin   Dir   Mag   E/W   N/S   Vert   Err   Echo1  Echo2  Echo3  Echo4
1     --    --    -32768 -32768 -32768 -32768  43    49    46    43
2     --    --    -32768 -32768 -32768 -32768  44    41    45    44
3     --    --    -32768 -32768 -32768 -32768  43    41    45    43
4     --    --    -32768 -32768 -32768 -32768  43    41    46    43
5     --    --    -32768 -32768 -32768 -32768  43    41    45    43
6     --    --    -32768 -32768 -32768 -32768  42    41    46    43
7     --    --    -32768 -32768 -32768 -32768  43    42    46    43
8     --    --    -32768 -32768 -32768 -32768  43    40    46    43
9     --    --    -32768 -32768 -32768 -32768  43    41    45    44
10    --    --    -32768 -32768 -32768 -32768  44    41    46    44
```

If all four beams have good data, then direction and magnitude are output as well.



CAUTION. PD8 output data format can not be recorded – it must be output through the serial port only. Do not use this output data format for a self-contained deployment.

14.9 H-ADCP Condensed 2D Output Format (PD14)

This section details the specification of an output format for data consisting of a header (with timestamp), a two dimensional profile of velocity, acoustic intensity, and standard error data, tilt sensor data, stage data, and a checksum. This format is primarily intended for use in horizontal H-ADCP applications. Data will be output in this format when PD14 is selected as the output format.



NOTE. This Output Data Format is only available for Horizontal H-ADCPs with firmware version 11.05 or later.

14.9.1 PD14 Format

Table 57 below summarizes the PD14 format. The number of bytes in the ensemble, not including the checksum is reported in the NBytes field and is equal to $10 * \text{NBins} + 23$ bytes, where NBins is the number of range cells in the profile. The NEnsemble field shows the number of ensembles since the start of a deployment and provides for tracking sequences of ensembles and distinguishing one ensemble from another. Tilts are reported as signed quantities in the interval -180.00 to $+180.00$ degrees. Stage measurements are reported as unsigned quantities in units of $1/10^{\text{th}}$ mm. Velocities are reported as signed quantities in mm/sec. Acoustic intensities are reported in unsigned units of counts. Standard error will be reported as unsigned quantities in mm/sec. The checksum will be calculated as described by the CRC-16 algorithm using the polynomial $x^{16} + x^{15} + x^2 + 1$ with an initial register value of 0xFFFF.

14.9.2 PD14 Invalid Data

Several quantities may on occasion be out of range or may not pass quality checks. In such cases, an invalid result will be indicated. For tilts, an invalid result will be indicated by a value of -327.68 degrees. Invalid velocities are indicated by a value of -32768 mm/s. Invalid standard error will be indicated by a value of 65535 (all bits set). Invalid stage measurements are indicated by a value of 42949.67295 meters (all bits set). No provision will be made for any other invalid quantities in this format.

Table 57: PD14 Output Data Format

Position	Size	Name	Description
0	2	SOE	Start of ensemble - always 0x8F8F
2	2	NBytes	Number of bytes
4	2	NEnsemble	Number of ensembles since start of deployment
6	2	Year	4-digit year
8	1	Month	Month
9	1	Day	Day of month
10	1	Hour	Hour of day since midnight
11	1	Minutes	Number of minutes since the last hour
12	1	Seconds	Number of seconds since the last minute
13	1	Hundredths	Hundredths of a second since the last second
14	2	Tilt 1	Tilt 1 measurement in 1/100 th degree
16	2	Tilt 2	Tilt 2 measurement in 1/100 th degree
18	4	Vertical	Vertical stage measurement in 1/10 th millimeter
22	1	NBins	Number of profile bins
23	2	X1	X component of velocity for bin 1
25	2	Y1	Y component of velocity for bin 1
-	-	-	-
4 <i>n</i> +19	2	X <i>n</i>	X component of velocity for bin <i>n</i>
4 <i>n</i> +21	2	Y <i>n</i>	Y component of velocity for bin <i>n</i>
4 <i>N</i> +23	1	I11	Beam 1 intensity for bin 1 (NBins = <i>N</i>)
4 <i>N</i> +24	1	I21	Beam 2 intensity for bin 1 (NBins = <i>N</i>)
-	-	-	-
4 <i>N</i> +2 <i>m</i> +21	1	I1 <i>m</i>	Beam 1 intensity for bin <i>m</i> (NBins = <i>N</i>)
4 <i>N</i> +2 <i>m</i> +22	1	I2 <i>m</i>	Beam 2 intensity for bin <i>m</i> (NBins = <i>N</i>)
6 <i>N</i> +23	2	SX1	Standard error of X component of velocity for bin 1 (NBins = <i>N</i>)
6 <i>N</i> +25	2	SY1	Standard error of Y component of velocity for bin 1 (NBins = <i>N</i>)
-	-	-	-
6 <i>N</i> +4 <i>m</i> +19	2	SX <i>m</i>	Standard error of X component of velocity for bin <i>m</i> (NBins = <i>N</i>)
6 <i>N</i> +4 <i>m</i> +21	2	SY <i>m</i>	Standard error of Y component of velocity for bin <i>m</i> (NBins = <i>N</i>)
10 <i>N</i> +23	2	Checksum	CRC-16

14.10 Output Data Format (PD16)



CAUTION. PD16 will **NOT** output data when the system is in Beam Coordinates (see [EX – Coordinate Transformation](#)). The data has to have been transformed to output meaningful data.



NOTE. When configured for PD16 and recording data to the recorder (CF11111), CS will start outputting data even if the card is full or missing.

The current generation of Sea-Bird acoustic modems uses the '\$' as a command terminator. This prevents them from handling the NMEA standard messages which all start with the '\$' character. Consequently, the current PD16 format is:

PRDIK,sn,yyddmm,hhmmss.ss,b₁,m₁,d₁,b₂,m₂,d₂,...,b_n,m_n,d_n*xx<cr><lf>

Where:

sn	= Serial Number
yyddmm	= Date
hhmmss.ss	= Time
b _x	= Bin Number
m _x	= Magnitude
d _x	= Direction
xx	= NMEA checksum

- In the event of bad data, the appropriate field will be left empty, with the commas present to indicate the absence of data.
- The bins to be displayed are selected using the PB command as in the case of PD12.
- The maximum length for the message is 480 bytes.



NOTE. Sea-Bird Electronics has acknowledged that they have a problem and are said to be changing their firmware to support the NMEA standard. At that time, use PD18 to meet the NMEA standard.

14.11 Output Data Format (PD18)

PD18 is the same Output Data Format as PD16, but with the leading '\$' necessary to fully comply with the NMEA format.



CAUTION. PD18 will **NOT** output data when the system is in Beam Coordinates (see [EX – Coordinate Transformation](#)). The data has to have been transformed to output meaningful data.



NOTE. When configured for PD18 and recording data to the recorder (CF11111), CS will start outputting data even if the card is full or missing.

15 How to Decode an H-ADCP Ensemble

Use the following information to help you write your own software.

15.1 Rules for the BroadBand Data Format PD0

- a. All data types (i.e. fixed leader, variable leader, velocity, echo intensity, correlation, percent good, etc.) will be given a specific and unique ID number. The table below shows some of the most common IDs.

Table 58: Common Data Format IDs

ID	Description
0x7F7F	Header
0x0000	Fixed Leader
0x0080	Variable Leader
0x0100	Velocity Profile Data
0x0200	Correlation Profile Data
0x0300	Echo Intensity Profile Data
0x0400	Percent Good Profile Data
0x0500	Status Profile Data
0x0600	Bottom Track Data
0x0800	MicroCAT Data

- b. Once a data type has been given an ID number and the format of that data has been published we consider the format for each field has being fixed. Fixed refers to units used for a given field, the number of bytes in a given field, and the order in which the fields appear within the data type. Fixed does not refer to the total number of bytes in the data type - see Rule “c”.
- c. Data may be added to an existing data type only by adding the bytes to the end of the data format. As an example, the variable leader data contains information on ensemble number, time, heading, pitch, roll, temperature, pressure, etc. The format for the bytes 1-53 are now specified by changes added in support to the H-ADCP. If additional sensor data is to be added to the variable leader data then it must be added to the end of the data string (bytes 54-x as an example).
- d. The order of data types in an ensemble is not fixed. That is there is no guarantee that velocity data will always be output before correlation data.
- e. The header data will include the number of data types in the files and the offset to each ID number for each data type.
- f. The total number of the bytes in an ensemble minus the 2-byte checksum will be included in the header.

15.2 Recommended Data Decoding Sequence for BroadBand Data Format PD0

- a. Locate the header data by locating the header ID number (in the case of PD0 profile data that will be 7F7F).
- b. Confirm that you have the correct header ID by:
 1. Locating the total number of bytes (located in the header data) in the ensemble. This will be your offset to the next ensemble.
 2. Calculate the checksum of total number of bytes in the ensemble excluding the checksum. The checksum is calculated by adding the value of each byte. The 2-byte least significant digits that you calculate will be the checksum.
 3. Read the 2-byte checksum word at the end of the ensemble, located by using the checksum offset in the header (determined in step “b-1”) and compare this checksum word to the value calculated in step “b-2”.
 4. If the checksums match then you have a valid ensemble. If the checksums do not match then you do not have a valid ensemble and you need to go back to step “a” and search for the next header ID number occurrence.
- c. Locate the number of data types (located in the header data).
- d. Locate the offset to each data type (located in the header data).
- e. Locate the data ID type you wish to decode by using the offset to each data type and confirm the data ID number at that offset matches the ID type you are looking for.
- f. Once the proper ID type has been located, use the H-ADCP Technical Manual for the H-ADCP you are using to understand what each byte represents in that particular data type.

15.3 Pseudo-Code for Decoding PD0 Ensemble Data

The following examples show the pseudo-code for decoding PD0 and PD5 ensemble data.

- g. Define structures, which contain all fields in all data types of the PD0 format.
 1. `typedef struct { <lists of types and fields> } FixedLeader.`
 2. `typedef struct { <lists of types and fields> } VariableLeader.`
 3. `typedef struct { <lists of types and fields> } BottomTrack.`
 4. `typedef struct { <lists of types and fields> } VelocityType`

5. and so on for every available type.
- h. Clear checksum.
- i. Look for PD0 ID 0x7F. Add to checksum.
- j. Is next byte a 0x7F? Add to checksum.
- k. If no, return to step “b”.
- l. Else, read next two bytes to determine offset to checksum. Add two bytes to checksum.
- m. Read in X more bytes, where X = offset to checksum - 4. Adding all bytes to checksum.
- n. Read in checksum word.
- o. Do checksums equal?
- p. If no, return to “b”.
- q. For each available data type (the header contains the # of data types), go to the offset list in header.
 1. Create a pointer to type short to the data type at an offset in the list.
 2. Check the Type ID.
 3. Create a pointer of appropriate type to that location.
 4. Repeat for all available data types.
- r. Work with data.
- s. Return to “b” for next ensemble.

15.4 Pseudo-Code for Decoding PD5 Ensemble Data

- a. Define structure that contains all fields in PD5 format.
 1. typedef struct { <lists of types and fields> } PD5_Format.
- b. Clear checksum.
- c. Look for ID, PD5 id is 0x7D. Add to checksum.
- d. Is next byte a 0x01? Add to checksum.
- e. If no, return to “b”.
- f. Else, read next two bytes to determine offset to checksum. Add two bytes to checksum.
- g. Read in X more bytes, where X = offset to checksum - 4. Adding all bytes to checksum.
- h. Read in checksum word.
- i. Do checksums equal?

- j. If no, return to “b”.
- k. Create a pointer of type PD5_Format.
 - 1. PD5_Format *PD5_ptr;
- l. Point pointer at location of ID byte.
 - 1. PD5_ptr = &buf[<location of input buffer>];
- m. If “k” and “l” don't appeal to you, you can create a variable of type PD5_Format.
 - 1. PD5_Format PD5_data;
- n. And copy the data from the input buffer to PD5_data.
- o. Work with data.
- p. Return to “b” for next ensemble.

15.5 Example Code for Decoding BroadBand Ensembles

Here is an example of how to decode a BroadBand ensemble. It is written in “C.”



NOTE. Structures must be “packed”; i.e. Don’t let the compiler add “fill bytes” to align fields on word boundaries.

This is an example of a section of code, not a full executable program.

```

/*****
/* Data ID Words */
*****/

#define FLdrSelected    0x0000
#define VLdrSelected    0x0080
#define VelSelected     0x0100
#define CorSelected     0x0200
#define AmpSelected     0x0300
#define PctSelected     0x0400
#define SttSelected     0x0500
#define BotSelected     0x0600
#define Prm0            0x0700

#define VelGood         0x0701
#define VelSum          0x0702
#define VelSumSqr       0x0703
#define Bm5VelSelected  0x0A00
#define Bm5CorSelected  0x0B00
#define Bm5AmpSelected  0x0C00
#define AmbientData     0x0C02
#define Bm5PctSelected  0x0D00
#define Bm5SttSelected  0x0E00
#define Prm0_5          0x1300
#define VelGood_5       0x1301
#define VelSum_5        0x1302
#define VelSumSqr_5     0x1303

/*****
/* structures */
*****/

typedef unsigned char  uchar;
typedef unsigned short ushort;

```

```

typedef unsigned long   ulong;

typedef struct {
    uchar    Minute,
             Second,
             Sec100;
}   TimeType;

typedef struct {
    uchar    Year,
             Month,
             Day,
             Hour,
             Minute,
             Second,
             Sec100;
}   DateTimeType;

typedef struct {
    uchar    Version,
             Revision;
}   VersionType;

typedef struct {
    uchar    ID,
             DataSource;
    ushort   ChecksumOffset;
    uchar    Spare,
             NDataTypes;
    ushort   Offset [256];
}   HeaderType;

typedef struct {
    ushort   ID;
    VersionType CPUFirmware;
    ushort   Configuration;
    uchar    DummyDataFlag,
             Lag,
             NBeams,
             NBins;
    ushort   PingsPerEnsemble,
             BinLength,
             BlankAfterTransmit;
    uchar    ProfilingMode,
             PctCorrelationLow,
             NCodeRepetitions,
             PctGoodMin;
    ushort   ErrVelocityMax;
    TimeType TimeBetweenPings;
    uchar    CoordSystemParms;
    short    HeadingAlignment,
             HeadingBias;
    uchar    SensorSource,
             AvailableSensors;
    ushort   DistanceToBin1Middle,
             TransmitLength;
}   FixLeaderType;

typedef struct {
    ushort   ID,
             EnsembleNumber;

    DateTimeType RecordingTime;
    uchar    Spare1;
    ushort   BITResult,
             SpeedOfSound,
             Depth,
             Heading;
    short    Pitch,
             Roll;
    ushort   Salinity;
    short    Temperature;
    TimeType MaxTimeBetweenPings;
    uchar    HeadingStddev,
             PitchStddev,
             RollStddev;
    uchar    VMeas [8];
}   VarLeaderType;

```

```

typedef struct {
    ushort    ID,
              PingsPerEnsemble,
              EnsembleDelay;
    uchar     CorrelationMin,
              AmplitudeMin,
              PctGoodMin,
              BTMode;
    ushort    ErrVelocityMax,
              NSearchPings,
              NTrackPings;
    ushort    Range      [4];
    short     Velocity   [4];
    uchar     Correlation [4],
              Amplitude   [4],
              PctGood     [4];
    ushort    WaterLayerMin,
              WaterLayerNear,
              WaterLayerFar;
    short     WVelocity   [4];
    uchar     WCorrelation [4],
              WAmplitude   [4],
              WPctGood     [4];
    ushort    MaxTrackingDepth;
    uchar     Amp [4];
    uchar     Gain;
    uchar     RangeMSB [4];
} BottomTrackType;

typedef struct
{
    ushort    ID;
    short     Data [256];
} OneBeamShortType;

typedef struct
{
    ushort    ID;
    uchar     Data [256];
} OneBeamUcharType;

typedef struct {
    ushort    ID;
    short     Data [1024];
} IntStructType;

typedef struct {
    ushort    ID;
    uchar     Data [1024];
} ByteStructType;

typedef struct
{
    ushort    ID;
    uchar     Data [4];
} AmbientType;

typedef struct
{
    ushort    ID;
    ushort    UaH;
    ushort    UaL;
    ushort    AmbBitsPerBin;
    ushort    AmbTrys;
    ushort    AmbNBins;
    short     AmbBinNum [ 5 ];
    short     Est [ 5 ];
    ushort    WAutoCor [ 5 ] [ 32 ];
    uchar     SysFreq;
    uchar     SampRate;
} T01Type;

typedef struct
{
    ushort    ID;
    uchar     DAC [36];
} T02Type;

```

```

typedef struct
{
    ushort      ID;
    ushort      RSSIBinLen;
    ushort      RSSIBins;
    uchar       RSSI [512] [4];
    ushort      AutoCor [32] [4];
    short       Est [4];
    ushort      Amb [4];
    uchar       SysFreq;
    uchar       SampRate;
    uchar       MLen;
    ushort      XmtSamples;
    ushort      FirstBin[4];
    ushort      LastBin[4];
    ulong       BM6Depth[4];
    ushort      BM6Ta[4];
} T03Type;

/*****
/* Global Pointers */
*****/
HeaderType      *HdrPtr;
FixLeaderType   *FLdrPtr;
VarLeaderType   *VLdrPtr;
BottomTrackType *BotPtr;
BottomTrackType *WBotPtr;
IntStructType   *VelPtr;
ByteStructType  *CorPtr;
ByteStructType  *AmpPtr;
ByteStructType  *PctPtr;
ByteStructType  *SttPtr;
AmbientType     *AmbientPtr;
T01Type         *T01Ptr;
T02Type         *T02Ptr;
T03Type         *T03Ptr;
OneBeamShortType *Bm5VelPtr;
OneBeamUcharType *Bm5CorPtr;
OneBeamUcharType *Bm5AmpPtr;
OneBeamUcharType *Bm5PctPtr;
OneBeamUcharType *Bm5SttPtr;

/*-----*/

unsigned char RcvBuff[8192];

void DecodeBBensemble( void )
{
    unsigned short i, *IDptr, ID;

    FLdrPtr = (FixLeaderType *)&RcvBuff [ HdrPtr->Offset[0] ];

    if (FLdrPtr->NBins > 128)
        FLdrPtr->NBins = 32;

    for (i=1; i<HdrPtr->NDataTypes; i++)
    {
        IDptr = (unsigned short *)&RcvBuff [ HdrPtr->Offset [i] ];
        ID = IDptr[0];

        switch (ID)
        {
            case VLdrSelected:
            {
                VLdrPtr = (VarLeaderType *)&RcvBuff [ HdrPtr->Offset [i] ];
                break;
            }
            case VelSelected:
            {
                VelPtr = (IntStructType *)&RcvBuff [ HdrPtr->Offset [i] ];
                break;
            }
            case CorSelected :
            {
                CorPtr = (ByteStructType *)&RcvBuff [ HdrPtr->Offset [i] ];
                break;
            }
        }
    }
}

```

```
    }
    case AmpSelected :
    {
        AmpPtr = (ByteStructType *)&RcvBuff [ HdrPtr->Offset [i] ];
        break;
    }
    case PctSelected :
    {
        PctPtr = (ByteStructType *)&RcvBuff [ HdrPtr->Offset [i] ];
        break;
    }
    case SttSelected :
    {
        SttPtr = (ByteStructType *)&RcvBuff [ HdrPtr->Offset [i] ];
        break;
    }
    case BotSelected :
    {
        BotPtr = (BottomTrackType *)&RcvBuff [ HdrPtr->Offset [i] ];
        break;
    }
    case AmbientData :
    {
        AmbientPtr = (AmbientType *)&RcvBuff [ HdrPtr->Offset [i] ];
        break;
    }
}
}
```

16 Firmware History

```

-----1-----2-----3-----4-----5-----6-----
                Workhorse Horizontal Firmware History
                  as of: 13OCT2008
                =====
                Current Firmware Version: 11.09
-----

UPGRADE NOTES:
When upgrading Workhorse firmware:
1. You can upgrade your CPU firmware yourself by downloading the
   latest version from our Web/FTP sites. Documentation is
   included with the self-extracting file that explains how to
   do this. The file name you want to download has the
   following format:

                               [SystemType][VersionNumber]!.exe

   For example: WHH3FIRM.EXE contains the files needed to
   upgrade the Workhorse Horizontal CPU firmware to version
   11.01.
-----
Version 11.01 (20JULY2001 - 11OCT2001):
-Initial Release of new product.
-----
Version 11.03 (11OCT2001 - 04APR2002):
-Fixed a bug which caused bottom searching to occur in 50%
  bandwidth.
-Fixed a bug which causes BM5 pings while processing BM4.
-Fixed bug that caused a divide by zero exception when three
  beam solutions were turned on.
-Changed default WM1 Ambiguity Velocity from 170 to 185 cm/s.
-Changed default transformation matrix. There was an error
  in the error velocity scaling.
-----
Version 11.04 (04APR2002 - 09AUG2002):
-Implemented ability to select 20°, 25°, or 30° head angles.
-Fixed a bug which caused the unit to attempt to load pressure
  coefficients when no sensor or coefficients existed.
-Fixed a bug which could prevent the beam matrix and temp offset
  from being loaded.
-----
Version 11.05 (09AUG2002 - PRESENT):
-Implemented code to support 2 beam systems.
-Implemented PD14 Data output format, for further assistance
  contact RDI Customer Service.
-Fixed Bug which could result in the wrong beam angle being used
  in system.
-----
Version 11.06 (14JUL2003 - PRESENT):
-Ported PD8 output format over from WHM/S/LR.
-----
Version 11.07 (22JUL2004 - PRESENT):
-Changed maximum tilt from +-20 degrees to +-60 degrees
  (Bug #1062).
-Altered to prevent the system from hanging when WI is set to 1
  (Bug #771).
-Modified to ignore the first digit of the p/n suffix when
  determining the board/system frequency (Bug #889).
-Changed value for bad bins in beam mode from 0 to -32768
  (Bug #1032).
-Updated the parameter defaults (Bug #1018).
-Added ability to flag data for WAVES processing.
-Removed support for water modes, until each mode can be vetted
  for proper handling of beam 3.
-Changed to always mark beam 4 bad for a 3-beam system, and to

```

mark beams 3 & 4 bad for a 2-beam system.
-Changed maximum number of bins to 255.
-Changed BP command default from BP1 to BP0

Version 11.08 (1MAY2008 - 13OCT2008):

- Corrected problems with retaining baud-rate across breaks.

Version 11.09 (13OCT2008 - PRESENT):

- Added NMEA output formats (PD16 & PD18)
- Added CG command. Default value is zero. If CG is set to one, data for beams 1 & 2 is swapped (for inverted installations).
- For earth and ship coordinate transformations, Z-component data is marked as bad. For instrument coordinates, it is marked as zero.
- Changed the number of beams reported in PD0 to 3.
- Beam 4 is now marked bad when collecting raw-beam data.
- Corrected handling of negative EB values when in PD3.
- Added packets mode
- Disabled internal salinity sensor setting (EZ).
- Polled mode and soft break are now mutually exclusive.
- TP setting is now respected in polled mode. Note that excessively short ping times will prevent keyboard input from being recognized.
- Corrected calculation of transmit length.
- Corrected the calculation of Y-axis velocities for pitch.
- Modified the format of the Pressure Sensor Coefficients to match those output by the Workhorse Monitor/Sentinel.
- Added NEMO compatible output buffering.
- Default values compatible with polled mode have been added for all frequencies.
- Added ability to disable Channel B Break Interrupts. (SB command)
- Corrected handling of open deployments when recorder is enabled or disabled.
- Roll angle is now ignored for transformations.
- Bin mapping is no longer supported. (EZ command)

NOTES

NOTES