WorkHorse

Horizontal H-ADCP

Deployment Guide

TELEDYNE MARINE
Everywhereyoulook™

P/N 957-6293-00 (July 2023)

https://www.teledynemarine.com

TABLE OF CONTENTS

HOW TO CONTACT TELEDYNE RD INSTRUMENTS

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

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

Client Services Administration – rdicsadmin@teledyne.com

Web: https://www.teledynemarine.com

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

Self-Service Customer Portal

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

Teledyne Marine Software Portal

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

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

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

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

Preparing the ADCP

PREPARING THE ADCP INCLUDES THE FOLLOWING STEPS:

- Checking you have all the H-ADCP parts
- Installing the documentation and software

Identifying what's in the Box

Included with the H-ADCP system:

Part Number	Name	Description
HADCP-I	H-ADCP 600 kHz H-ADCP 300 kHz H-ADCP 300 kHz Narrow Beam	The H-ADCP system includes the transducer and dummy plug. When unpacking, use care to prevent physical damage to the transducer face and connector. Use a soft pad to protect the transducer.
	H-ADCP Accessories Kit	Contains the I/O cable, shipping case, software, and documentation listed below.

Included with the H-ADCP Accessories Kit:

Part Number	Name	Description
73B-3030-005	I/O cable	The I/O cable is used for serial communications.
737-3008-025	Extension Cable	25-meter extension cable
717-3014-00 PO3-6	AC Power Adapter Power cord	AC power adapter provides 48 VDC
737-3010-00	RS232/RS422 Converter	If you ordered RS-422 communications, a RS-232 to RS-422 adapter will be added.
MRDI1004 305D0550-4	Shipping case	Shipping case with custom foam cutouts.
95Z-6007-00	Download instructions	This sheet has instructions for downloading the software and manuals.
	TRDI Toolz Software	Utility and testing software package that can be used to test the H-ADCP.
	WavesMon Software (optional) WavesView Software (optional)	Waves is a feature upgrade for 300 kHz NB H-ADCPs. *WavesMon* is the directional wave measurement package for the H-ADCP. Use *WavesView* to view wave data. It is an enormously useful tool for turning waves data into waves information.
957-6294-00	H-ADCP Getting Started sheet	A printed reference showing H-ADCP connection.
757K6085-00	Mounting Kit (optional)	Optional mounting kit for 300/600 kHz H-HADCPs
757K6073-00 757K6071-00	Tools and Spare Parts kit	See Tools and Spare Parts for a list of parts included in these kits.

Tools and Spare Parts

A set of tools and spare parts are included with the system (located in the canvas bag).

H-ADCP 300 Narrow Beam ADCP Spare Parts (P/N 757K6071-00)

Part Number	Description	Where Used
5020	Silicone Lubricant, 4-Pack	Inside Housing
97Z-6052-00	O-Ring, 2-260	
97Z-6050-00	O-Ring, 2-258	
97Z-6068-00	O-Ring, Backup, 8-258	
DES3	Desiccant, Sealed Bag	
M10COMBINATION	Wrench, 10MM COMB.	Used to attach housing to transducer.
M13COMBINATION	Wrench, 13MM COMB.	
7289A16	Key, Hex, 5M	
7289A17	Key, Hex, 6M	
305D0010	Bushing, Inst. housing	
810-4004-00	Bushing, Inst. housing	
M6WASHSPLTI	Washer, 6MM Split Lock	
M6WASHSTDTI	Washer, Flat, 12.5MM OD	
M6X1.0NUTTI	Nut, Hex, 10MM	
M6X1.0X45HHTI	Screw, Hex Head,	
M8WASHSPLTI	Washer, Split Lock,	
M8WASHSTDTI	Washer, Flat, 22.9MM OD	
M8X1.25NUTTI	Nut, Hex, 13MM	
M8X1.25X65HHTI	Screw, Hex Head, Full Threads Length	
817-1067-00	Screw, Pressure Sensor	Pressure Sensor

H-ADCP 300 and 600 kHz ADCP Spares Parts (P/N 757K6073-00)

Part Number	Description	Where Used
97Z-6052-00	O-RING, 2-260, DURO 70, EPDM	Inside Housing
5020	Silicone lubricant, 4-pack	
DES2	Desiccant bag	
M10COMBINATIO	Wrench, 10mm Comb.	Used to attach housing to transducer.
7289A16	Key, Hex, 5M	
M6WASHNYLON	Washer, Flat, 6.4 ID 12.5 OD, Nylon	
M6WASHSPL	Washer, Split Lock SST316	
M6WASHSTD	Washer, Flat,12.5MMOD SST 316	
M6X1.0NUT	Nut, Hex, SST 316	
M6X1.0X45HH	Screw, Hex Head, SST 316	
206062-1	Clamp, Cable, Plastic Shell	AC power adapter
206430-2	Receptacle, 4 Pin, Free Hang	
66101-4	Socket, Crimp, 18-16AWG	
817-1067-00	Screw, Pressure Sensor	Pressure Sensor

Installing Documentation and Software

The H-ADCP documentation and software are downloaded.

1. Follow the instruction sheet on downloading TRDI software and manuals.
2. Software is available on https://tm-portal.force.com/TMsoftwareportal. Install *TRDI Toolz*. This program is required for set up and testing. Install *WavesMon* for collecting and post-processing waves data. Optional software: *Velocity*.
3. Use our online customer portal at https://www.teledynemarine.com/support/RDI/technical-manuals to download manuals or other Teledyne RDI documentation. Download the H-ADCP Guide. PDF versions of all H-ADCP documentation are available for download.

H-ADCP Guide

Registering Velocity

When you purchase the *Velocity* software, you will receive an Activation code that unlocks the software.

To activate Velocity:

- On the License Registration screen, enter your activation code (*xxxx-xxxx-xxxx-xxxx*). Click the **Activate** button. Click the **OK** button and then **OK** once more to close the License registration screen.

The Velocity Activation Code sheet is in the documentation kit.

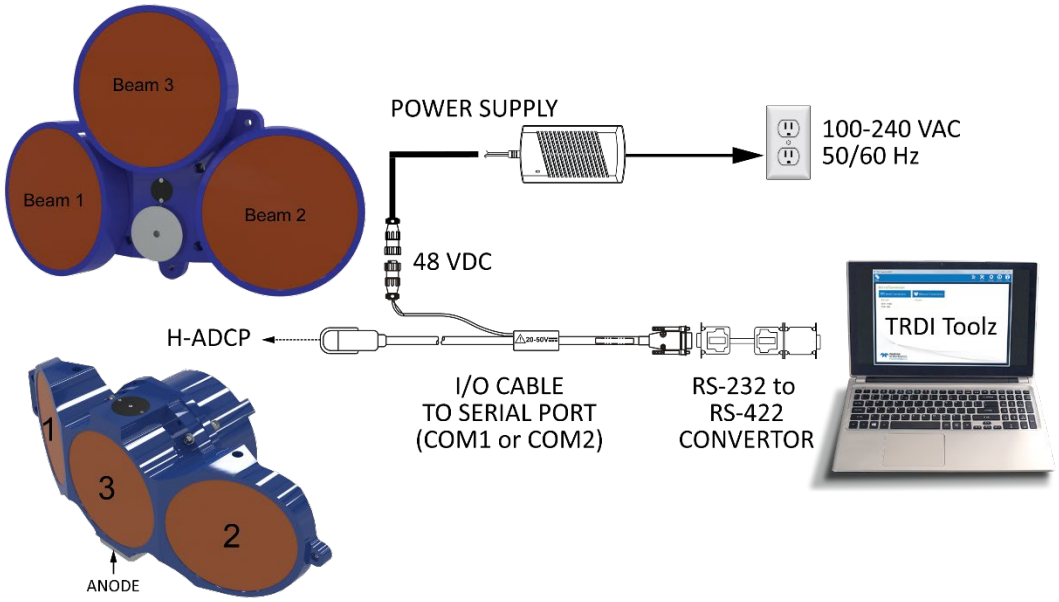
Quick Review

	
✔ Check that you have all the H-ADCP parts.	If you are missing parts, contact TRDI support rdifs@teledyne.com or call +1 (858) 842-2700.
✔ Check that the software and documentation is installed.	Install TRDI Toolz and Velocity. Read the H-ADCP documentation.

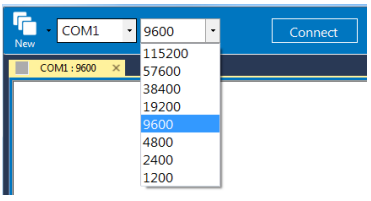
Connecting to the ADCP

CONNECTING TO THE ADCP INCLUDES THE FOLLOWING STEPS:

- Using TRDI Toolz

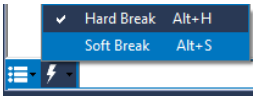


Connecting to the ADCP



To establish communications with the H-ADCP:

1. Connect the system and apply power.
2. Start the *TRDI Toolz* software.
3. Select **New Serial Connection**.
4. Enter the ADCP's communication settings. Select the **COM Port** the serial cable is connected to and set the **Baud Rate** from the drop-down lists. If you are unsure of the ADCP's baud rate, use **Tools**, **Find ADCP**. *TRDI Toolz* will try different baud rates until it connects to the ADCP.
5. Click the **Connect** button. Once connected, the button will change to **Disconnect**.
6. Click the **Break** ( ) button. From the **Break** button drop down menu, select **Hard Break**. The wakeup banner will display in the terminal window.




```
[BREAK Wakeup B]
WorkHorse Horizontal Broadband ADCP Version 11.11
Teledyne RD Instruments (c) 1996-2015
All Rights Reserved.
>
```

Quick Review

	
✔ Verify the wakeup banner displays	If you are unsure of the ADCP's baud rate, use **Tools**, **Find ADCP**. *TRDI Toolz* will try different baud rates until it connects to the ADCP. The factory default Baud Rate is 9600.

Deploying the ADCP

DEPLOYING THE ADCP INCLUDES THE FOLLOWING STEPS:

- Setting the ADCP clock
- Testing the ADCP
- Calibrating the Compass
- Deploying the H-ADCP

Pre-Deployment Checks

TRDI Toolz has a user-friendly interface for running the pre-deployment tests and setting the H-ADCP real-time clock.

Refer to the H-ADCP Operation Manual for a listing of all direct commands and their format.

Setting the ADCP Clock

The real-time clock (date and time) within the H-ADCP maintains the correct time while system power is removed. The clock is powered by a lithium battery on the CPU board.

To set the ADCP's clock to match the PC time:

1. Setup the communication parameters between *TRDI Toolz* and the ADCP.
2. Wake up the ADCP by pressing the button.
3. Click **Tools**, **PC Time to ADCP**.
4. *TRDI Toolz* will send the TS command to set the clock.

```
[BREAK Wakeup B]
WorkHorse Horizontal Broadband ADCP Version 11.11
Teledyne RD Instruments (c) 1996-2015
All Rights Reserved.
>TS 21/06/17 09:50:34
>
```

Testing the ADCP

To run the Built-in tests:

1. Setup the communication parameters between *TRDI Toolz* and the ADCP.
2. Wake up the ADCP by pressing the button.
3. Enter the PA command and then press the **Enter** key or click on **Send**.

If any of the tests fail, read Chapter 6 in the H-ADCP Operation Manual.

Testing the Sensors

To test the sensors:

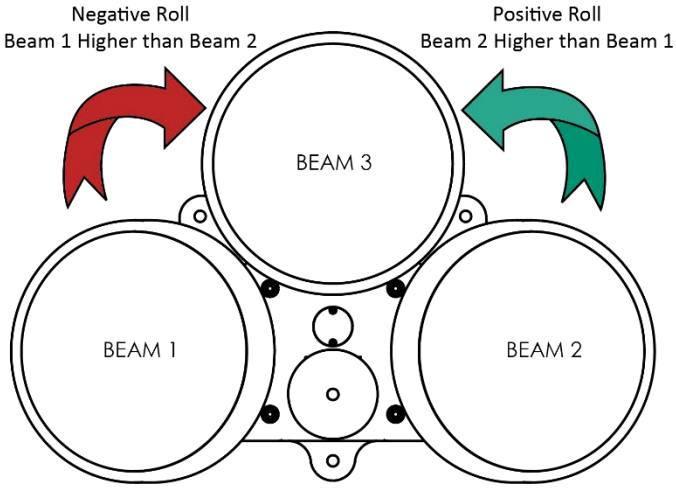
1. Setup the communication parameters between *TRDI Toolz* and the ADCP.
2. Wake up the ADCP by pressing the button.
3. Enter the PC2 command and then press the **Enter** key or click on **Send**.

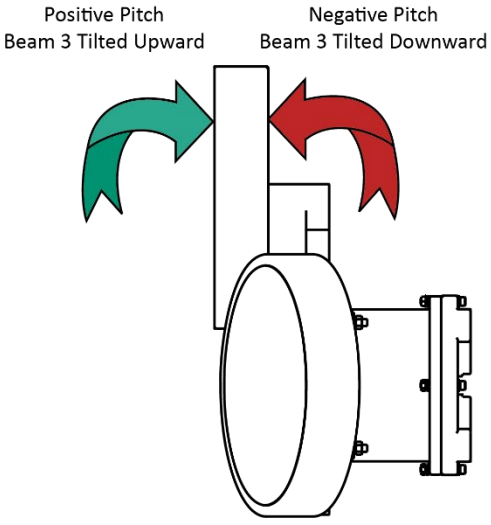
```
Press any key to quit sensor display ...
Heading   Pitch    Roll   Up/Down    Attitude Temp   Ambient Temp  Pressure
301.01°  -7.42°  -0.73°     Up          24.35°C         22.97°C       0.0 kPa
300.87°  -7.60°  -0.95°     Up          24.36°C         22.97°C       0.0 kPa
```

4. Rotate and tilt the system and verify the Pitch and Roll sensor data is reasonable. Rotate the system clockwise and verify the heading increases. Validate the accuracy at 0, 90, and 180 degrees. If the heading is off by more than 2 degrees, calibrate the compass. If the Depth sensor is not zero, zero the pressure sensor.

When an H-ADCP is orientated properly and horizontal, PC2 Up/Down will state it is orientated downward.

The 300 kHz NB H-ADCP should only be rotated/tilted by holding onto the transducer mounting plate. Do not rotate/tilt by holding onto the housing, end-cap, or beams. The system weight can cause serious damage to the H-ADCP or personnel lifting the unit.





5. If a sensor fails, contact TRDI Field Service.

Zero the Pressure Sensor

Zero the pressure sensor at the deployment site, prior to deploying the H-ADCP in the water.

To zero the pressure sensor:

1. Setup the communication parameters between *TRDI Toolz* and the ADCP.
2. Wake up the ADCP by pressing the button.
3. Enter the AZ command and then press the **Enter** key or click on **Send**.

Calibrating the Compass

Verify the compass if any ferrous metals are relocated inside or around the H-ADCP housing. Calibrate the compass if the system has been moved to a new location.

Refer to the H-ADCP Operation Manual, Chapter 4 for details on compass calibration.

Deploying the H-ADCP

Use *WavesMon* to collect real-time waves data.

See WavesMon User's Guide, Chapter 3.

H-ADCP Wave System Installation Checklist

Waves is a feature upgrade for 300 kHz NB H-ADCPs.

For information on how to use the Waves commands, see the WavesMon User's Guide.

✓ **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 1: 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 outperform 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** to calculate waves data.

Quick Review

	
✔ All maintenance items (as needed) were done including set clock, zero pressure sensor, and compass calibration.	TRDI recommends that if you are having trouble calibrating the H-ADCP compass that you move the system and/or ensure the area around the system is clear of electrical equipment and ferrous materials. Read Chapter 2 in the H-ADCP Operation Manual for information on how to install/mount the ADCP for a deployment.
✔ Collect Real-Time Waves Data	See WavesMon User's Guide, Chapter 3.

Recovering Data

RECOVERING DATA INCLUDES THE FOLLOWING STEPS:

- Downloading data files

Downloading Data Files

To download a data file:

1. Setup the communication parameters between *TRDI Toolz* and the ADCP.
2. Wake up the ADCP by pressing the  button.
3. Click **Tools**, **Download Data**.
4. *TRDI Toolz* sends the RY command to recover the data. The RY command uploads the entire contents of the CompactFlash memory card via the serial interface to a host computer using the standard YMODEM protocol for binary file transfer. The data is transferred to the host and stored as binary files.
5. Once the data has been recovered, the CompactFlash memory card can be erased by sending the command RE ErAsE. This command *is* case sensitive. *Once erased, the data is not recoverable.*

Opening a Data File with Velocity

When a **.PD0* (pd zero, not the letter o) file is opened, *Velocity* creates a matching **.pdv* and **.pjv* files depending on the options selected. The **.pdv* file is used to process data and the **.pjv* file contains the latest information about user selections for processing parameters and data displays.

The original *.pd0 file is never changed, moved, or overwritten.

To open a data file:

1. Start *Velocity*.
2. Click the **Home** button () located in the top left corner.
3. Click the **Options** button and select the options. Data averaging is on by default.
4. Do one of the following:
   - Drag a data file onto the *Velocity* desktop icon. This will start *Velocity* and open the data file.
   - With the **Start** menu selected, on the **Starting actions** area, click **Open a data file** button.
   - Click the **Open** menu button.
5. After the file is opened, a mini preview of the data file will display at the top of the Velocity screen. Click the preview to switch to the session (if other files are opened).

Quick Review

	
Download the data.	Use TRDI Toolz to download data.
Check and process the data	Read the WavesMon Software User's Guide for information on how to check and process data.

Conclusion

Congratulations! You have completed the H-ADCP Deployment Guide. Read the following chapters in the H-ADCP Operation Manual for more detailed information.

H-ADCP Operation Manual

- Chapter 1 – Overview
  This chapter includes an overview of the H-ADCP features, options, computer, power requirements, and connecting to the H-ADCP.
- Chapter 2 – Installation
  Use this chapter to plan your installation requirements.
- Chapter 3 –Collecting Data
  Use this chapter for an overview of collecting data using *WavesMon* or *Velocity*.
- Chapter 4 – Maintenance
  This chapter covers H-ADCP maintenance. Use this section to make sure the H-ADCP is ready for a deployment.
- Chapter 5 – Troubleshooting
  This chapter covers how to troubleshoot the H-ADCP. If the H-ADCP fails a built-in test or you cannot communicate with the system, use this information to help locate the problem.
- Chapter 6 – Returning Systems to TRDI for Service
  Use this information to obtain a Return Material Authorization (RMA) number if the H-ADCP needs to be returned to TRDI.
- Chapter 7 – Specifications
  This chapter includes specifications and dimensions for the H-ADCP (including outline installation drawings).
- Chapter 8 – Commands
  This chapter explains how commands used by the H-ADCP.
- Chapter 9 –Output Data Format
  This chapter explains the PD0 output data format used by the H-ADCPs.

PDDecoder Library in C language

The Teledyne Marine PDDecoder library is an open-source library written in C language to decode the PD0 data formats that are commonly output by Teledyne Marine/Teledyne RD Instruments ADCPs. The definition and details of the PD0 format can be found in any of the manuals under the section, Output Data Format.

Available for download from the Teledyne software portal: https://tm-portal.force.com/TMsoftwareportal