PATHFINDER

OEM

INTEGRATION GUIDE

TELEDYNE RD INSTRUMENTS
Everywhereyoulook™

P/N 95B-6121-00 (August 2017)

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NOTES

Getting Started with the Pathfinder

Identifying what's in the Box

Pathfinder OEM Inventory

Part Number	Name	Description
70B-9043-xx	Pathfinder DVL OEM version	The Pathfinder ROV 600 kHz system includes the transducer and electronics chassis. When unpacking, use care to prevent physical damage to the transducer face and connectors. Use a soft pad to protect the transducer.
97B-7011-00 97B-7012-00	OEM hard Shipping Case OEM cardboard	Shipping case with foam inserts.
73B-6060-00	OEM PWR/COMM Pigtail Cable	The DVL PWR/COMM pigtail cable allows you to build custom cable to connect the Pathfinder to your vehicle/platform. It provides all the leads for serial and Ethernet COM, Power and Trigger.
95B-6116-00	Pathfinder DVL Software and Documentation CD	This CD has PDF versions of all of the Pathfinder DVL software and documentation including the Pathfinder DVL Guide. Please read the manual! The CD also includes the TRDI Toolz Software. TRDI Toolz is a utility and testing software package that can be used to test the DVL.
95B-6120-00	Pathfinder OEM Getting Started Guide	A printed quick start card showing test setup is included. A PDF version is included on the documentation CD.
95B-6121-00	Pathfinder OEM Integration Guide	A printed quick reference showing how to integrate the Pathfinder OEM DVL onto a ROV. Refer to Chapter 2 of the Pathfinder DVL guide for detailed instructions.
2-037 5020	O-ring and Lubricant	Remote OEM Transducer head O-ring and lubricant

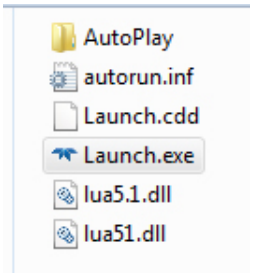
This list only shows the part included with the standard OEM Pathfinder DVL. See the packing slip for additional options. If you are missing parts, contact TRDI support rdifs@teledyne.com or call +1 (858) 842-2700.

Installing Documentation and Software

The Pathfinder system includes a CD with the documentation and all software needed for the Pathfinder system.

To install the Pathfinder Documentation and Software CD:

1. Insert the CD into the drive and follow the browser instructions on the screen. If the browser does not start automatically, complete steps 2 through 3.
2. Use Windows Explorer® to open the CD drive folder.
3. Double-click on the *launch.exe* file. Follow the browser to view or copy the documentation to your computer.



Many companies require that Autorun is disabled. Double-click on *Launch.exe* to start the browser on all TRDI software and documentation CDs.

4. Click **Start**, **All Programs**, **Teledyne RD Instruments** to locate the installed documentation and software.

Connecting to the Pathfinder

Power Overview

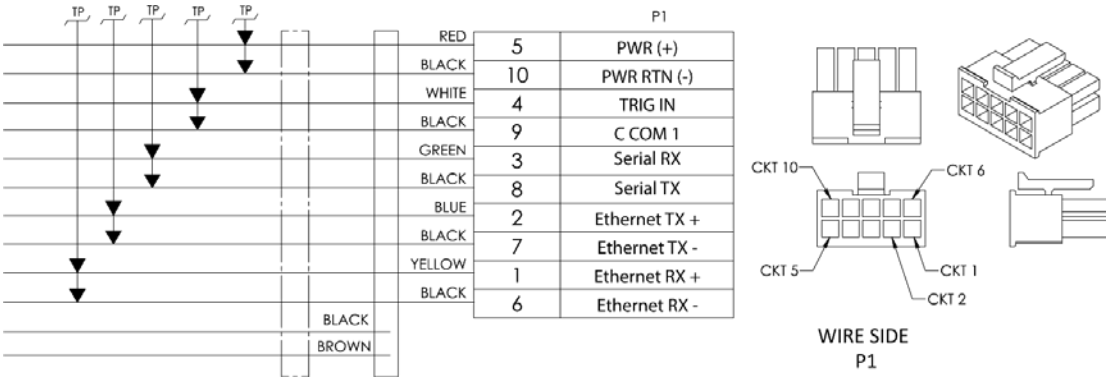
The Pathfinder requires a DC supply between 10.7 to 36 VDC. Either an external DC power supply or battery can provide this power. The power supply should be able to source at least two Amps for a bench test setup (no pinging).

Power on Cycle - 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 Pathfinder. The capacitors provide a store of energy for use during transmit. The inrush current is as much as four amps if plugged in after the DVL Transmit Cap is fully discharged. The Pathfinder will draw this amperage until its capacitors are fully charged (less than 200ms).

If the power supply limits the current or the power drop on the cable is significant, then the power on cycle will fail or the system will reset during pinging. Therefore, TRDI recommends a 1.5 to 2 Amp power supply to cover all performance cases.

If the Power is put in then removed within a very short time (few secs) and then applied again, then the Inrush limiter will not be able to limit the current pulled from the DVL which would result in a higher than 4Amps Inrush current spike.

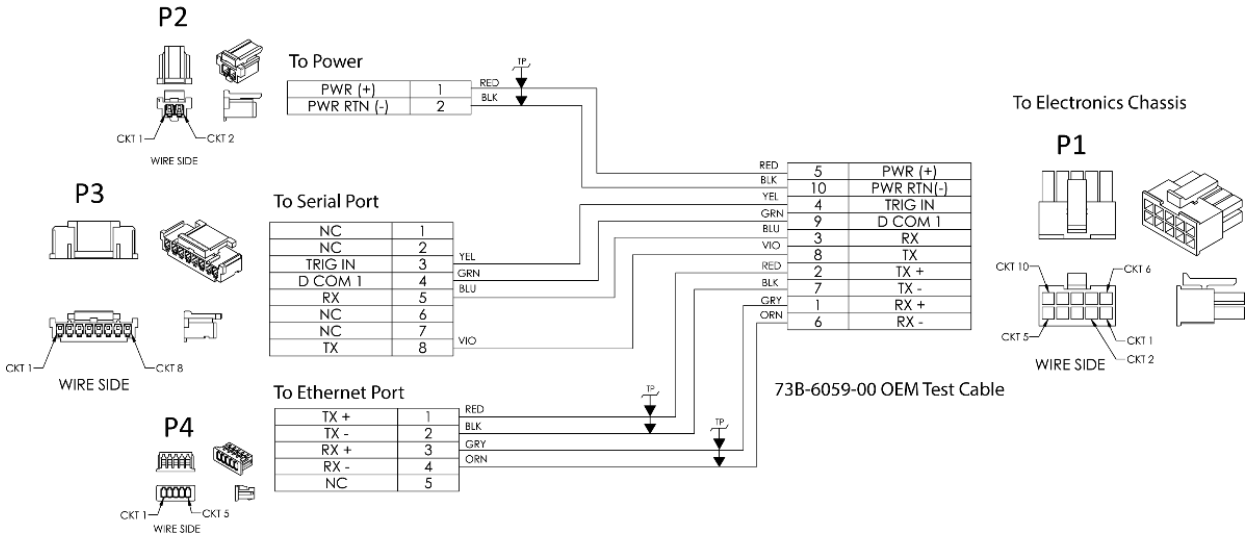
Wiring Diagrams



Pathfinder OEM Power/Comm Cable 73B-6060 Pigtail Cable

Using the Optional Test Cables

The optional OEM Power/Comm Test cable is included in the 75BK6088-00 Integration Kit



OEM Pathfinder Connections for Bench Test [73B-6059-00 Cable]

Using TRDI Toolz

To establish communications with the Pathfinder:

1. Connect the system and apply power.
2. Start *TRDI Toolz*.
3. Select **New Serial Connection** or **New Ethernet Connection**.

The command and control port can be Serial or Ethernet, but not both.

4. Enter the Pathfinder's communication settings.

Serial Communications:

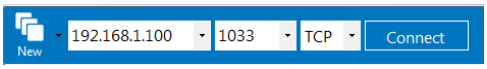
Select the **COM Port** the serial cable is connected to and set the **Baud Rate** from the drop down list to 115200

Ethernet Communications:

Enter the Static DHCP server **IP or host name** 192.168.1.100

Enter the **Port Number** 1033

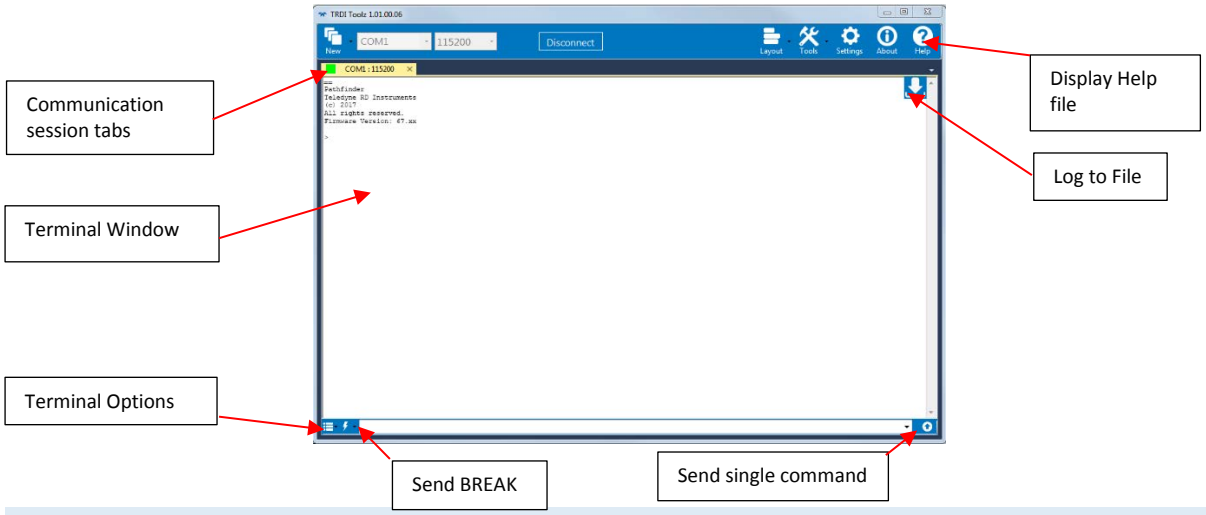
Select **TCP**



If the network assigns a Dynamic IP address, the Static IP address **192.168.1.100** will not work; Connect using the serial port and use the CE command to verify the IP adress. You must have the RJ45 connector plugged into the network switch for the CE command to return the Ethernet setting info.

There is a 10 to 15 second delay after power is applied before the serial or Ethernet port is available.

5. Click the **Connect** button. Once connected, the button will change to **Disconnect** and the tab will show a green box.
6. Click the **Break** ( ) button. The wakeup banner will be displayed in the Terminal window.



For more information on *TRDI Toolz*, click the Help icon ( ) to open the TRDI Toolz Software help file.

Using the Network Configuration Page

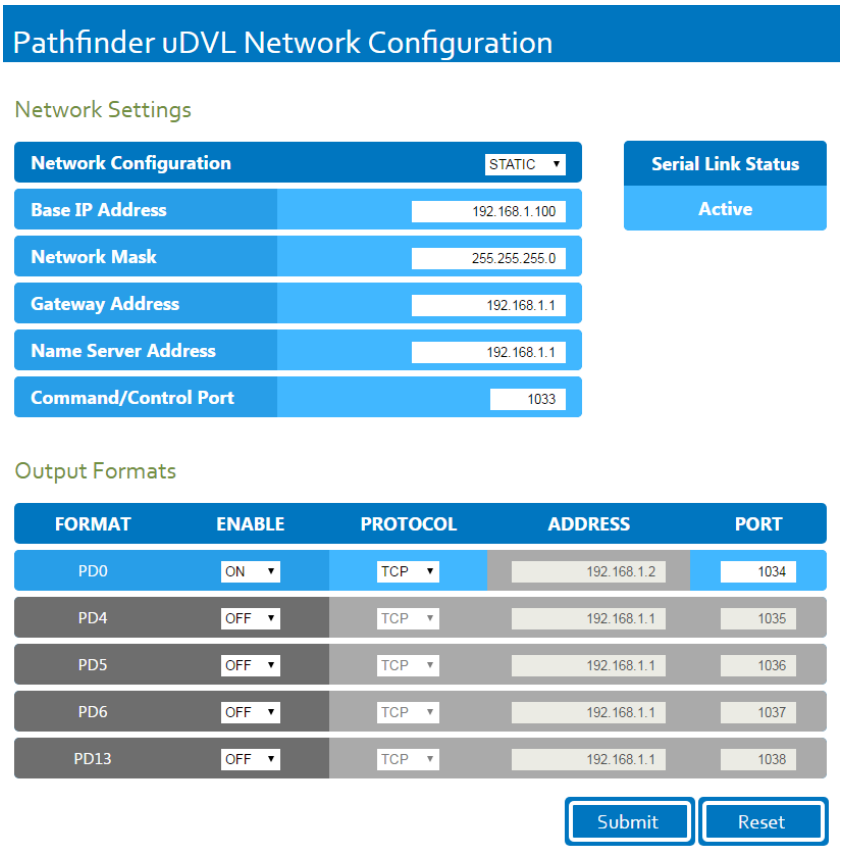
The system must be connected to the Ethernet port to use the Network Configuration page.

To establish communications with the Network Configuration page:

1. Connect the system and apply power.
2. Open a browser on the laptop (*Internet Explorer®*, *FireFox®*, *Google Chrome®*, or other browser).
3. Enter the Pathfinder's DHCP server IP address **192.168.1.100** into the address bar.
4. On **Network Configuration**, choose **STATIC** or **DHCP**. Use Dynamic Host Configuration Protocol (DHCP) server protocol when the network automatically provides an Internet Protocol (IP) host with its IP address and other related configuration information such as the subnet mask and default gateway.

   If you are using a STATIC network, then configure the **Base IP Address**, **Network Mask**, **Gateway Address**, **Name Server Address**, and **Command/Control Port** as needed. The default configuration is shown below.
5. On the Output Formats section, enable or disable the output data formats (PD0, PD4, PD5, PD6, and PD13), **Protocol** (**TCP** or **UDP**), **Address**, and **Ports**. Once done, click **Submit**.

If all outputs are enabled, it can affect the ping rate.



Pathfinder Network Configuration Page

Testing the Pathfinder DVL

To test the Pathfinder:

1. Interconnect the system and apply power.
2. Place the Pathfinder transducer in water (at least a few inches to cover the transducer face).
3. Start the *TRDI Toolz* program and connect.
4. Click the **Break** ( ) button. The wakeup banner appears on the Terminal window.

```
Pathfinder
Teledyne RD Instruments (c) 2017
All rights reserved.
Firmware Version: 67.xx
>
```

5. Enter the following commands in the command box:
   - Enter **CR1** then press the icon. This will set the Pathfinder to the factory default.
   - Enter **CK** then press the icon. This will save the factory default setting.
   - Enter **PA** then press the icon. This will run the Pathfinder Pre-Deployment test.

Submerge the transducer face in a few inches of water. The PA test may fail in air. Only a failure with the transducer in water is a relevant test.

This test may fail if the Pathfinder is exposed to electrical interference such as that from other acoustic devices or SONARs or other electronic devices (i.e. cellphones, radios, computers, TV's, etc.).

```
>PA
ROM Test...PASS  [ 3aad ]
RAM test...PASS
FRAM test...PASS
Receive Buffer Test...PASSED
XMIT RAM Test....PASSED
Receive Path Test (Hard Limited)...PASSED
Transmit/Receive Continuity Check...PASSED
Composite Result:
    GO for Deployment
```

6. If the wakeup banner displays and PA message displays with a result of "GO for Deployment", the Pathfinder is functioning normally.

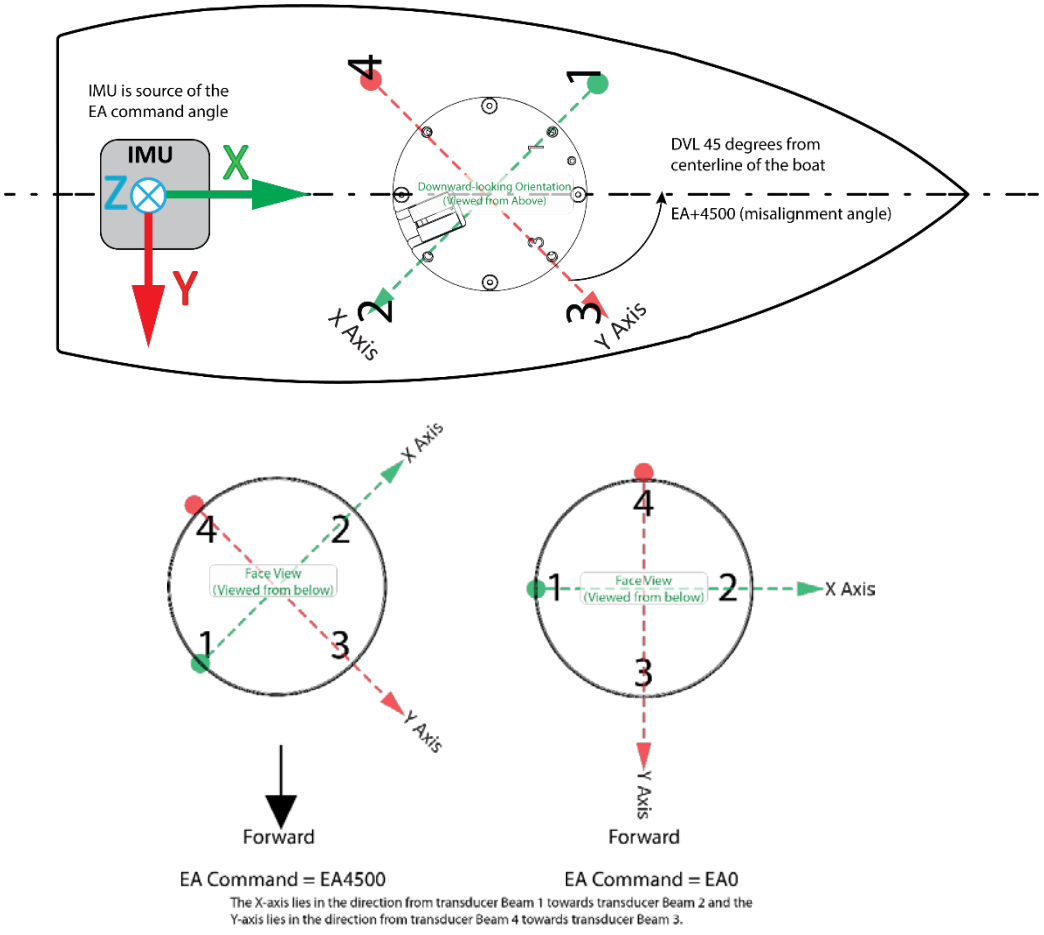
Mechanical Integration

Alignment

The mechanical alignment of the transducer head is important to DVL data accuracy. Mechanically mount the head as close as possible to your reference point. You also must mount the transducer head as level as possible using the ship's roll and pitch references.

TRDI recommends mounting the transducer head with Beam 3 (instrument Y-axis) rotated 45° relative to the ship forward axis.

Mounting the transducer head with Beam 3 (instrument Y-axis) rotated 45° relative to the ship forward axis causes the magnitude of the signal in each beam to be about the same. This improves error rejection, reduces the effect of ringing, and increases the Pathfinder's effective velocity range by a factor of 1.4. If Beam 3 is aligned at an angle other than zero, use the EA command to describe the rotation between instrument Y-axis (beam 3) and ship forward axis.

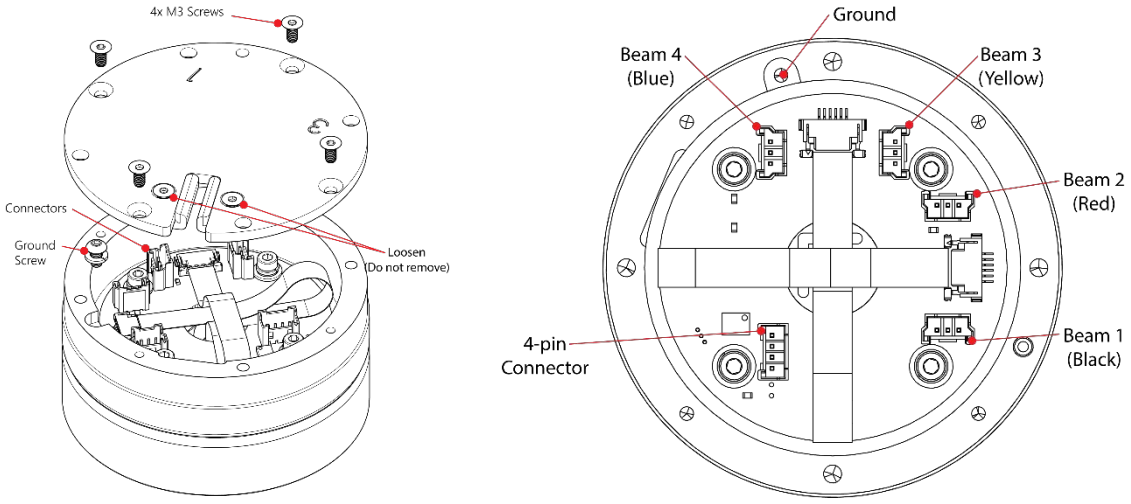


Transducer Alignment Reference Points

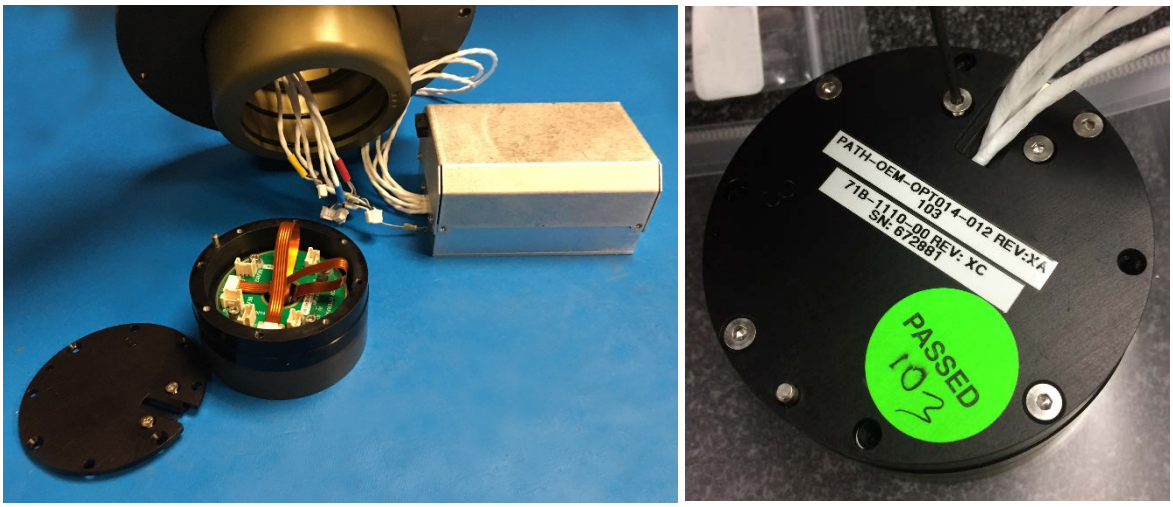
Installing the DVL on the Vehicle

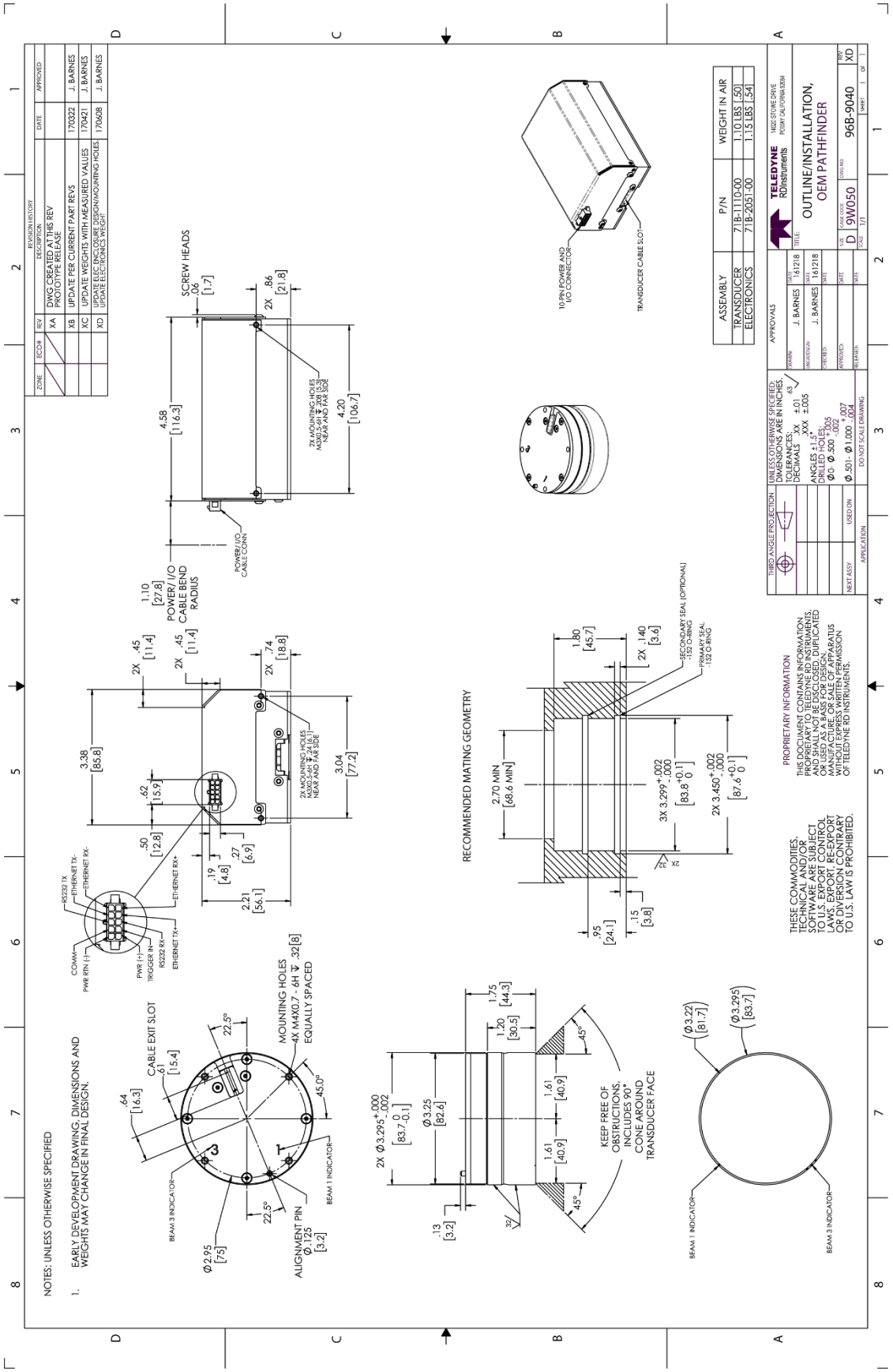
To install the OEM Pathfinder:

1. Place the Pathfinder transducer face down on a soft surface.
2. With an ESD wrist strap on, remove the top cover on the transducer. Loosen, but do not remove the two screws next to the cable exit slot.
3. Connect the five cables and ground wire. The 3-pin beam cables have the beam number on the connector and are color-coded: Beam 1 = black, Beam 2 = red, Beam 3 = yellow, Beam 4 = blue. Attach the only 4-pin connector to the board. Tighten the ground screw to 4 IN-LB.
4. Thread the cables through the slot and attach the cover. Tighten the four M3 screws on the cover to 4 IN-LB. Tighten the two screws next to the cable exit slot to hold the cables in place.
5. Connect P1 to the Electronics Chassis.
6. Attach the Power/Comm cable to the computer's serial or Ethernet communication port.
7. Connect +10.7 to 36 VDC power. The power supply should be able to source at least 1.5 to 2 Amps.



OEM Pathfinder Transducer Connections




NOTES: UNLESS OTHERWISE SPECIFIED
1. EARLY DEVELOPMENT DRAWING. DIMENSIONS AND WEIGHTS MAY CHANGE IN FINAL DESIGN.
REVISION HISTORY
ZONE | ECO# | REV | DESCRIPTION | DATE | APPROVED
XA | DWG CREATED AT THIS REV PROTOTYPE RELEASE | 170322 | J. BARNES
XB | UPDATE PER CURRENT PART REVS | 170421 | J. BARNES
XC | UPDATE WEIGHTS WITH MEASURED VALUES
XD | UPDATE CONNECTOR DESCRIPTION/MOUNTING HOLES | 170608 | J. BARNES
UPDATE ELECTRONICS WEIGHT
SCREW HEADS .06 [1.7]
4.58 [116.3]
4.20 [106.7]
2X .86 [21.8]
2X MOUNTING HOLES M3X0.5-6H ↧ 2X8 [5.1] NEAR AND FAR SIDE
POWER/ I/O CABLE CONN
1.10 [27.8] POWER/ I/O CABLE BEND RADIUS
10 PIN POWER AND I/O CONNECTOR
TRANSDUCER CABLE SLOT
ASSEMBLY | P/N | WEIGHT IN AIR
TRANSDUCER | 71B-1110-00 | 1.10 LBS [.50]
ELECTRONICS | 71B-2057-00 | 1.15 LBS [.54]
TELEDYNE RDInstruments
14020 STOWE DRIVE POWAY CALIFORNIA 92064
APPROVALS
DRAWN J. BARNES 161218
ENGINEER J. BARNES 161218
CHECKED
APPROVED
RELEASED
TITLE: OUTLINE/INSTALLATION, OEM PATHFINDER
SIZE D | CAGE CODE 9W050 | DWG NO 96B-9040 | REV XD
SCALE 1/1 SHEET 1 OF 1
THIRD ANGLE PROJECTION
UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES [MM]
TOLERANCES: DECIMALS .XX ±.01 .XXX ±.005
ANGLES ±1.5°
DRILLED HOLES: Ø.D Ø.500 +.005 -.002
Ø.501 - Ø1.000 +.007 -.004
NEXT ASSY | USED ON | APPLICATION | DO NOT SCALE DRAWING
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RECOMMENDED MATING GEOMETRY
2.70 MIN [68.6 MIN]
1.80 [45.7]
2X .140 [3.6]
SECONDARY SEAL (OPTIONAL) -152 O-RING
PRIMARY SEAL -152 O-RING
3X 3.299 +.002 -.000 [83.8 +0.1 0]
2X 3.450 +.002 -.000 [87.6 +0.1 0]
.95 [24.1]
.15 [3.8]
2X Ø3.295 +.000 -.002 [83.7 0 -0.1]
Ø3.25 [82.6]
1.75 [44.3]
1.20 [30.5]
1.61 [40.9]
KEEP FREE OF OBSTRUCTIONS, INCLUDES 90° CONE AROUND TRANSDUCER FACE
.13 [3.2]
32
45°
3.38 [85.8]
.62 [15.9]
.50 [12.8]
2X .45 [11.4]
2X .74 [18.8]
2X MOUNTING HOLES M3X0.5-6H ↧ 24 [6.1] NEAR AND FAR SIDE
3.04 [77.2]
.19 [4.8]
.27 [6.9]
2.21 [56.1]
COMM
PWR RTN (-)
PWR (+)
TRIGGER IN
RS232 RX
RS232 TX
ETHERNET TX-
ETHERNET RX-
ETHERNET RX+
ETHERNET TX+
CABLE EXIT SLOT .61 [15.4]
.64 [16.3]
MOUNTING HOLES 4X M4X0.7 - 6H ↧ .32[8] EQUALLY SPACED
22.5°
45.0°
Ø2.95 [75]
ALIGNMENT PIN Ø.125 [3.2]
BEAM 3 INDICATOR
BEAM 1 INDICATOR
(Ø3.22) [81.7]
(Ø3.295) [83.7]

Electrical Integration

Grounding Issues

Multiple grounds connected to a vehicle hull or to a vehicle chassis can have undesirable consequences. Grounding problems can be avoided by implementing prudent grounding schemes.

The DVL has three isolated grounds in order to achieve the desired performance levels of the instrument. The grounding systems are as follows:

- Communication ground
- Power ground
- Chassis ground

Bypassing or shorting the DVL isolation / ground noise filter circuit will increase the sensitivity of the DVL to vehicle noise, which will increase noise floor in the instrument and in the data, thereby resulting in a reduced operational range and data contamination from interference. Additionally, bypassing of the DVL isolation/ground filter can lead to accelerated corrosion.

Your Pathfinder DVL transducer housing is made of aluminum that is protected by sacrificial anodes and a hard anodize coat and paint. **Do not connect other metal to the DVL.** Other metals may cause corrosion damage.

Use M6 isolating bushings and washers when mounting the DVL to a metal structure. Keep this in mind when fabricating a fixture, which materials to use, or deciding how to place it on the vehicle.

Electro-Magnetic Interference (EMI)

The main sources of EMI are induced voltages from signal and power lines that are located in proximity to the effected component or signal. These problems are avoided or minimized by the proper routing of wires, proper shielding of wires and proper location of individual systems components. EMI is also caused by unwanted differences in potential on signal or ground electronic lines.

For more information, see the Pathfinder Guide, Chapter 2 – System Integration, Identifying EMI.

Acoustic Integration

The following items must be taken into consideration when using the Pathfinder DVL.

Flow Noise – Water flowing over the transducer faces increases the acoustic noise level, which in turn decreases the operational range of the DVL. Flow noise can be reduced across the transducer faces by mounting the DVL behind a sea chest, fairing, or acoustic window. Flow noise can also be reduced by optimizing the transducer head type and design to conform to the platform hull form being used.

Cavitation – Cavitation is the formation of air bubbles due to the reduction of ambient pressure because of hydrodynamic flow conditions. Cavitation at the edges of the transducer or surrounding area near the transducer often results in increased acoustic noise, and a corresponding reduction in operating range. As with flow noise, cavitation can also be reduced by optimizing the transducer head type and design to the platform hull form being used.

Ringing – Ringing occurs in DVLs when the energy from the side lobes of the transmitted signal excites the metal portion of the DVL transducer such that a resonant condition occurs. This causes the transducer and anything attached to it to resonate at the system's transmit frequency. While some ringing is normal in DVLs, its magnitude must be minimized.

Windows Use Considerations – Windows can be used to produce overall performance improvements in vessel-mounted DVLs. There are several advantages and disadvantages to consider before using an acoustic window.

Advantages

- Well will not fill with air bubbles caused by the ship moving through the surface water.
- Flow noise is reduced.
- The well can be filled with fresh water to limit corrosion.
- Barnacles cannot grow on the transducer faces. Barnacle growth is the number one cause of failure of the transducer beams.
- The transducer is protected from debris floating in the water.

Disadvantages

- The range of the DVL may be reduced because the window can and will absorb some of the transmit and receive energy.
- The transmit signal could be reflected into the well, causing the well to "ring". This will cause the data being collected during the ringing to be biased. Some vessels have reported a loss in range as great as 50 meters. As noted, the ringing may be damped by applying sound absorbing material on the well walls (standard neoprene wet suit material has been found to work well).
- The transmit signal could be reflected off the window and back into the other beams.

SONAR Interference Considerations – Interference from other acoustic and electromagnetic devices can cause velocity and direction bias. In extreme cases, interference may prevent the DVL from operating.

For more information, see the Pathfinder Guide, Chapter 2 – System Integration.

Operational & Setup Integration

The following items must be taken into consideration when using the Pathfinder DVL.

Unfavorable Environments – There are certain environmental conditions where the DVL's errors may be large or where the instrument does not function at all.

- In the surf zone where waves are actively breaking, the acoustic beams may not be able to penetrate the bubble clouds, and even if they do, the sound speed may be significantly affected by the high concentration of bubbles. This changes the Doppler scale factor.
- The dense growth of weeds or kelp on the bottom may prevent the DVL from detecting the true bottom. If the DVL locks onto the top of the weeds by mistake, they may have motion relative to the bottom due to wave action, which would give inaccurate velocity measurements.
- In areas of high salinity (>35ppt), the absorption of the sound by the water column will reduce the altitude capability of the DVL. Absorption (maximum range) can also be affected by water temperature.
- In areas where the salinity varies as a function of location and/or time, the Doppler scale factor will be varying and it may be necessary to integrate a speed-of-sound sensor into the navigation system to keep the velocity measurement errors to an acceptable value. Temperature gradients can cause similar issues. This is only for the Z-axis velocity, as Speed of Sound does not impact 2D velocities on a Phased Array Transducer.

Triggering – There are two methods for triggering the DVL:

- **Sending ASCII Character through Serial Port**. When the system is interfaced to a serial port (e.g. a navigation computer), the system can be setup to wait for an input before each ping. To setup the DVL in this fashion, clear the Auto Ping Cycle bit in the CF command by sending CFx0xxx, where the x's represent the settings of the other parameters. Start the DVL pinging with the CS command. The DVL will output a '<' before each ping and wait for input. Send any valid ASCII character to trigger the ping. The instrument will not enter sleep mode while it is waiting for the trigger.
- **Using Low-Latency Triggering**. The trigger methods shown above all have latencies ranging from a few milliseconds to a few hundred milliseconds, which may be excessive for high-precision applications. Consequently, TRDI has developed a low-latency trigger method (see CX command). To configure the DVL for low-latency triggering, set the CX command to enable trigger input. Start the DVL pinging with the CS command. The DVL will then wait for a trigger before each ping. Setting the trigger lines to a break state for no less than 10 microseconds sends the trigger. The DVL will then ping within 1 millisecond of the leading edge of the break pulse. Note that it is possible through the CX command settings to set a timeout for the DVL to wait for a Trigger and then shall no Trigger occur during that time it will either Self Deploy and never look for Trigger again or Ping once and then go back to waiting for Trigger.

For more information, see the Pathfinder Guide, Chapter 2 – System Integration and Chapter 7 - Commands.

Choosing a Data Format

Deciding on which output data 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, DVL setup, orientation, heading, pitch, roll, temperature, pressure, and self-test diagnostic results. Data fields to be output are user selectable.

- **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. If PD6 is selected, there is no data written to the recorder.

- **PD13** - PD13 outputs similar to PD6, except it adds Pressure and Range-to-bottom for all four beams, and omits the System Health Monitor Data line.

For more information, see the Pathfinder Guide, Chapter 8 – Output Data Formats.

Want to know more?

Congratulations! You have completed the Pathfinder Integration Guide. Read the following chapters in the Pathfinder Guide for more detailed information.

- Chapter 1 –Pathfinder Overview
  This chapter includes an overview of the Pathfinder features, options, computer and power requirements, and connecting to the Pathfinder DVL.
- Chapter 2 – System Integration
  This chapter covers system integration in detail.
- Chapter 3 – Collecting Data
  Use this chapter to create a command file that will be used to collect data.
- Chapter 4 – Maintenance
  This chapter covers Pathfinder DVL maintenance. Use this section to make sure the Pathfinder is ready for a deployment.
- Chapter 5 – Returning Systems to TRDI for Service
  Use this information to obtain a Return Material Authorization (RMA) number if the Pathfinder DVL needs to be returned to TRDI.
- Chapter 6 – Specifications
  This chapter includes specifications and dimensions for the Pathfinder DVL (including outline installation drawings).
- Chapter 7 – Commands
  This chapter defines the commands used by the Pathfinder.
- Chapter 8 – Output Data Formats
  This chapter defines the output data formats used by the Pathfinder.