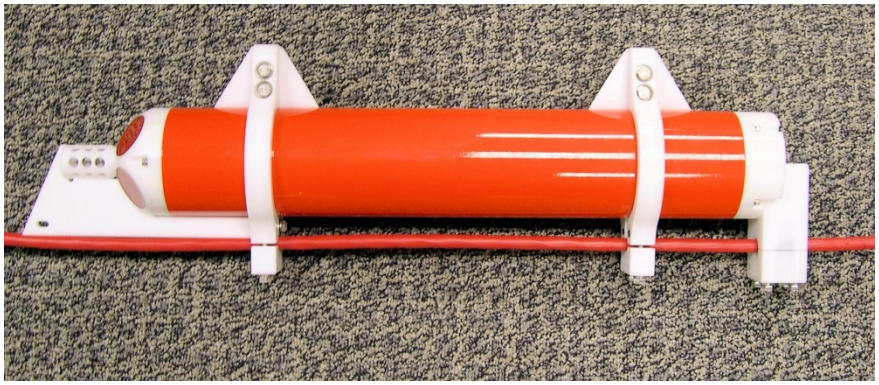
Doppler Volume Sampler (DVS™) User's Guide



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Doppler Volume Sampler (DVS) User's Guide

Introduction

Thank you for purchasing the Teledyne RD Instruments (TRDI) Doppler Volume Sampler[1] (DVS™). This User's Guide will lead you through the steps required for a successful deployment. Please read the entire guide, and then follow the instructions in the order they are presented. Additional information can be found in the DVS Operation Manual that is supplied on CD-ROM.

NOTE. To purchase a printed copy of the DVS documentation (includes the DVS Operation Manual and software guides), contact our Customer Service department at rdifs@teledyne.com or call (858) 842-2600 and order the DVS Manual kit.

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:

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[1] DVS is a registered trademark of Teledyne RD Instruments, Inc.

Overview

The first step is to become familiar with the DVS. Read the short descriptions of the hardware and software that comes with the DVS.

This Section Covers:

- Hardware Overview
- Battery Packs and Power Overview
- Serial Communication Overview
- Deployment Overview
- Software Overview
- Installing the Software

Hardware Overview

The DVS system consists of a DVS, test cable, battery pack, and the *DVS* software program. The DVS requires the addition of a Windows® compatible computer to configure the DVS and replay collected data.

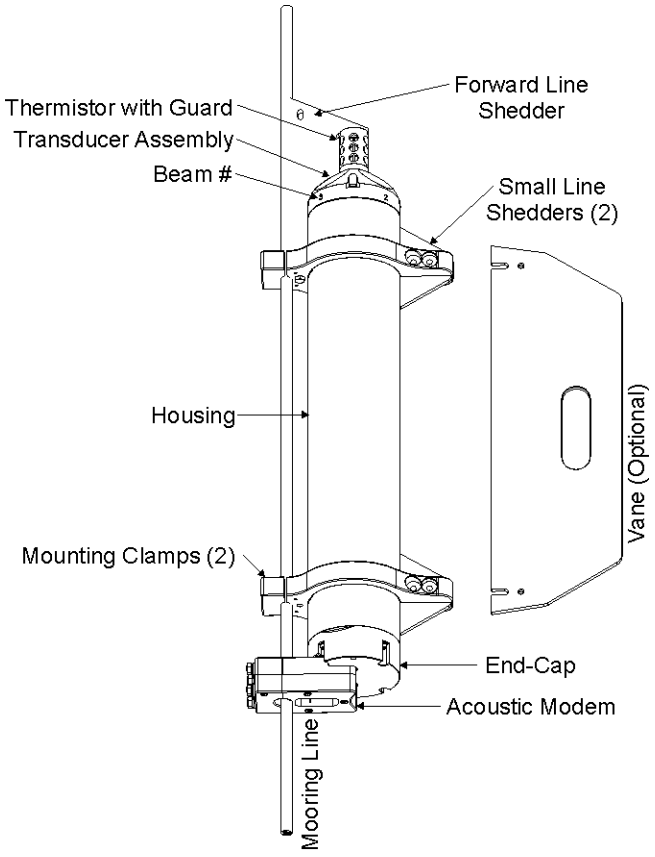


Figure 1. DVS Overview

NOTE. Mounting hardware and line shedders are available from Teledyne RD Instruments. Please contact your local sales representative for further information or if you desire assistance in applying the DVS to your specific situation.

The DVS assembly contains the transducer ceramics and electronics. The standard acoustic frequency is 2400 kHz. See the outline drawings in the DVS Operation Manual for dimensions and weights.

Transducer Assembly – The primary function of the transducer is to convert electrical energy to acoustic energy and back again. Four beams are positioned at 90-degree intervals around the transducer. The faces of the beams point away from the housing into the water at a 45-degree angle.

Beam-# – The numbers embossed on the edge of the transducer assembly indicates the beam number.

Housing – The standard DVS housing allows deployment depths to 750 meters. The high pressure DVS housing allows deployment depths to 6000 meters.

Temperature Sensor – The High Resolution Temperature Sensor provides extremely accurate temperature data to the DVS. The temperature sensor is an OEM version of the Sea-Bird Electronics SBE38. A plastic guard protects the sensor. The DVS can be configured with either the Sea-Bird thermistor or the standard TRDI thermistor.

End-Cap – The End Cap can be configured with either the inductive modem or with an underwater connector, but not both. Internal electrical connections inside the end cap consist of one full duplex RS232 serial port and a DC input via the test cable.

Inductive Modem Module - The Inductive Modem Module (IMM) provides a communication interface for the DVS to a surface buoy via the mooring cable. The DVS uses an OEM low power UIM manufactured by Sea-Bird Electronics.

Internal Battery Pack – DVS units use an internal battery pack to provide power to the DVS. The DVS uses a pack of 12 D cell alkaline batteries in series, physically configured as three stacks of four cells for a nominal voltage level of 18 VDC.

Mounting Clamps (Optional) – Teledyne RD Instruments has available mounting clamps that are keyed to a notch in the housing to provide reproducible orientation to the mooring line.

Fins / Line Shedders (Optional) – Teledyne RD Instruments has available triangle pieces and another fin that comes up over the top of the thermistor guard to help keep the DVS from becoming a catch point (for fishing lines and such).

Large Vane (Optional) – The optional large Vane can be attached opposite to the mooring line to help reduce instrument vibration should the mooring line start strumming.

NOTE. Mounting hardware and line shedders are available from Teledyne RD Instruments. Please contact your local sales representative for further information or if you desire assistance in applying the DVS to your specific situation.

Battery Packs and Power Overview

DVS units require +10.8 to 28 VDC to operate. Use an external power supply to run the DVS when the battery is not connected. The DVS internal battery supplies +18 VDC.

Keep in mind the following about battery packs:

- When the instrument is setup properly, the battery can provide enough energy for a one-year deployment.
- A Standard DVS battery packs hold 12 'D-cell' alkaline batteries with a voltage, when new, of approximately 18 VDC.
- When the capacity of a battery pack is 50% used, the voltage (measured across the battery connector) falls to approximately 14 to 15 volts. However, keep in mind that this voltage is not an accurate predictor of remaining capacity.
- Transmitted power increases or decreases depending on the input voltage (with-in the voltage range of 10.8 to 28 VDC). A fresh battery provides +18 VDC.
- Batteries spend most of their life at a nominal voltage of +15 VDC.

NOTE. When the voltage falls from +15 VDC to +9 VDC at the end of the battery life, the profiling range for a 2400 kHz DVS is also reduced by about 20%.

- Batteries should be replaced when the voltage falls below 13 VDC (measured across the battery connector).
- Battery packs differ from one to another.
- Store batteries in a cool dry location (0 to 21 degrees C).
- Do not store batteries inside the DVS for extended periods. The batteries may leak.
- Use batteries within one year (shelf life).

NOTE. Battery replacement induces both single and double cycle compass errors. The compass must be calibrated after replacing the battery pack.

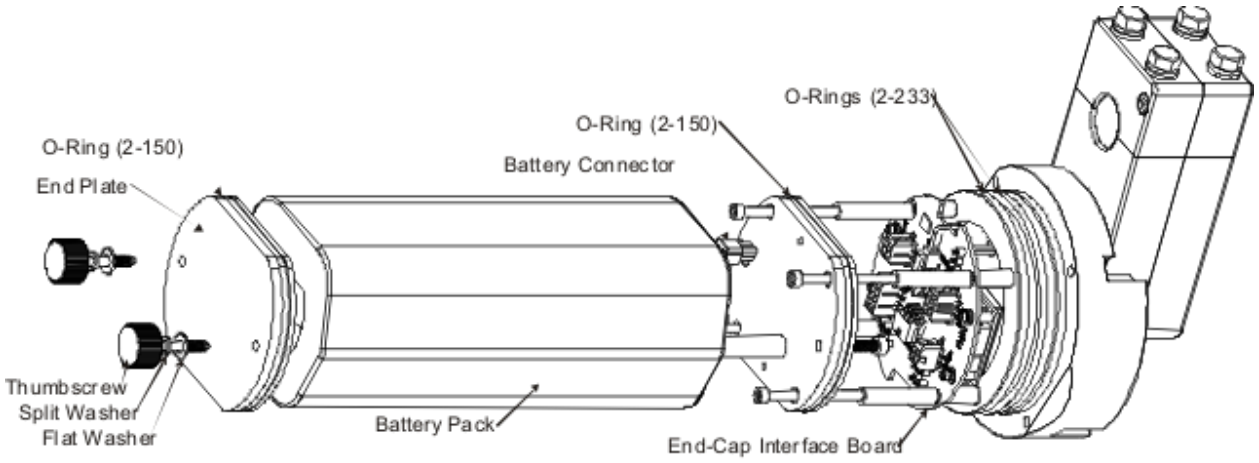


Figure 2. Standard DVS Battery Pack and End-Cap Assembly

Communication Overview

The standard communications settings using the test cable with the DVS is RS-232, 9600-baud, no parity, 8 data bits and 1 stop bit. You can set the DVS for baud rates other than 9600 baud using the DVS software (see "Connecting to the DVS," page 13). The *DVS* software will use the last communication setting for future use.

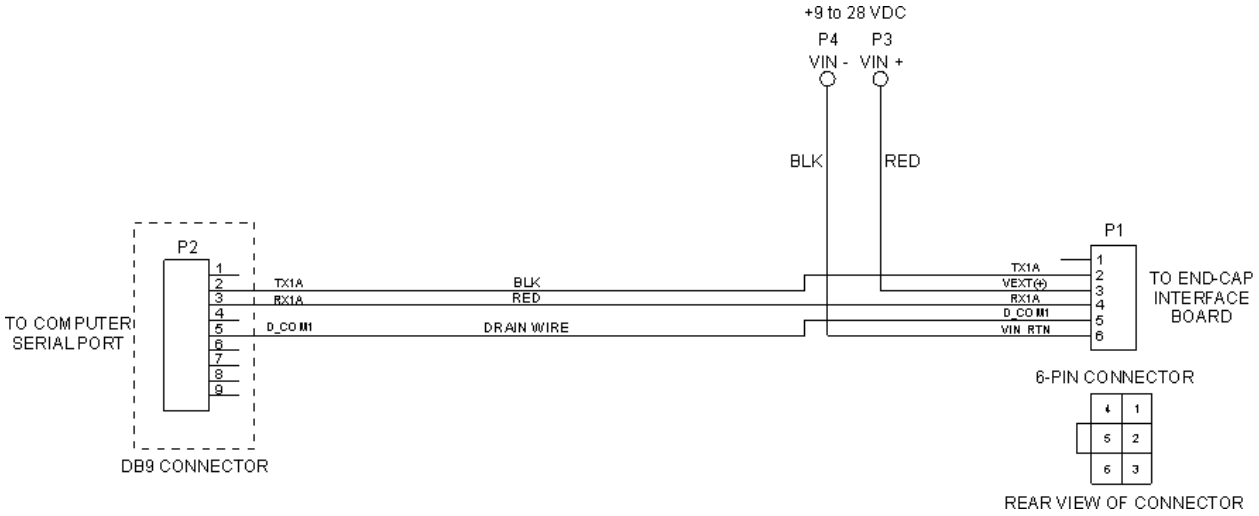


Figure 3. Test Cable Wiring Diagram

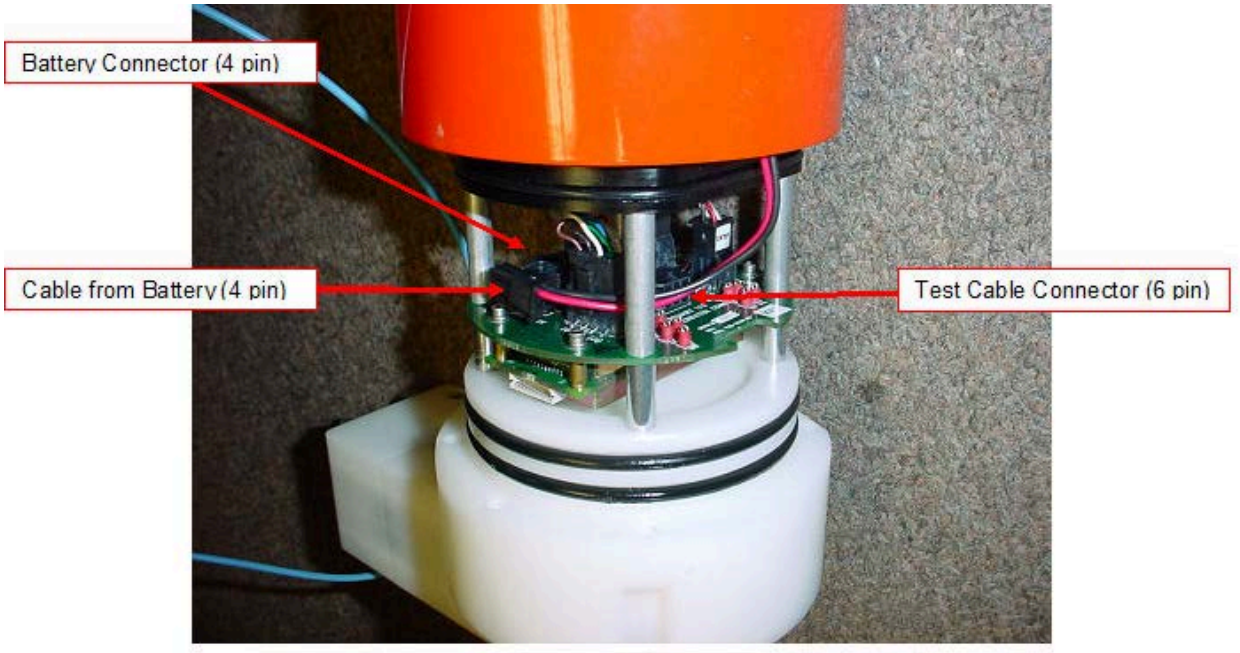
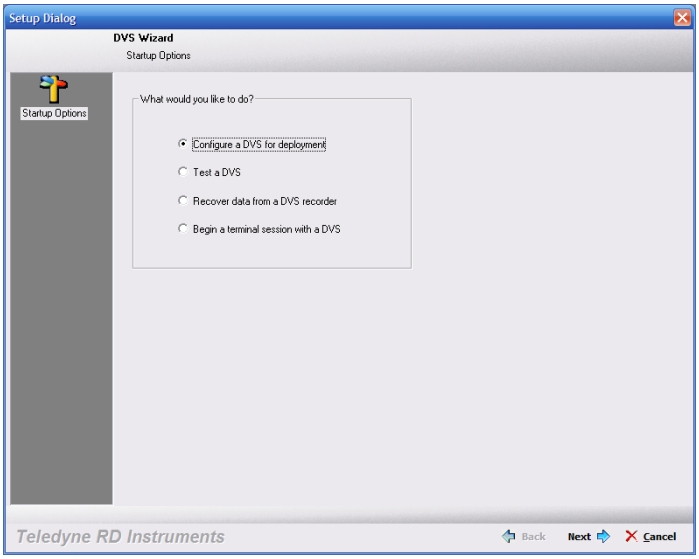


Figure 4. Test Cable Connection

Software Overview

You will use two software programs to setup the DVS and view data.

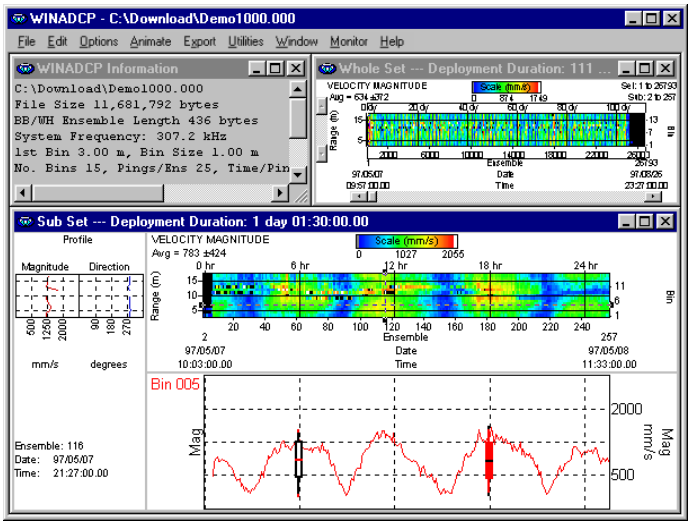


DVS Wizard Screen

The *DVS* software is designed to set up a DVS for collecting data. Specifically, The *DVS* software will set the DVS commands correctly.

The *DVS* software shows you an overview of your setup and the resulting consequences of your deployment.

For detailed information on how to use The *DVS* software, see the DVS Software User's Guide and "Final Preparation for Deployment," page 29.



WinADCP Main Screen

WinADCP gives users a visual display of the entire set of data. You can zoom in on a portion of the data for closer analysis and export data to text or MatLab files.

Use *WinADCP* to view color contour and time-series plots of data collected with a DVS in real-time or playback data collected with a DVS.

For detailed information on how to use *WinADCP*, see the WinADCP User's Guide and "Viewing Data with WinADCP," page 37.

Installing the Software

You will be installing several software packages. These will be required for testing and deployments.

The DVS system requires a Windows® compatible computer with the following specifications:

- Windows XP® or Windows 2000®
- Pentium III 400 MHz class PC (higher recommended)
- 64 megabytes of RAM (128 MB RAM recommended)
- 10 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

Software Installation

a. Insert the compact disc into your CD-ROM drive and then follow the browser instructions on your screen. If the browser does not appear, complete Steps "b" through "d."
b. On the Windows task bar, click the **Start** button, and then click **Run**.
c. Type <drive>:launch. For example, if your CD-ROM drive is drive D, type d:launch.
d. Follow the browser instructions on your screen

DVS Preparation

Proper DVS preparation is critical for a successful deployment. In this section, we will prepare the DVS for deployment.

NOTE. DVS preparation can take place up to one month before the deployment in a land-based laboratory. It may be configured for deployment at this time, with a programmed wake-up time for the anticipated time of deployment.

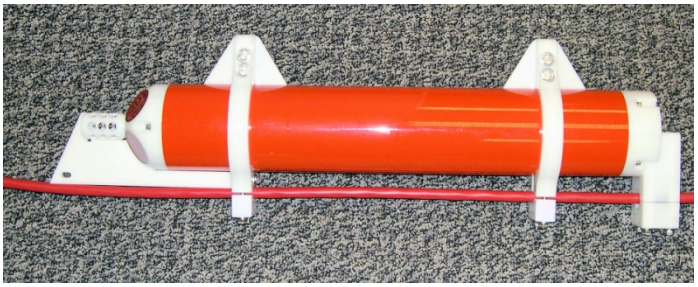
Deployment Checklist

- **Visual Inspection and Cleaning**
  - Check the housing condition for damage
  - Check the transducer faces are clean and free from defects
  - Clean the optional temperature sensor guard
  - Apply antifouling paint as needed
- **Bench Test**
  - Test the DVS unit using the *DVS* software
  - Align the compass using the *DVS* software
- **Seal the DVS for deployment**
  - Install and connect the battery
  - Use fresh desiccant (1 bag) inside DVS
  - Install new o-rings; use silicone lubricant
  - Check all mounting hardware is installed
- **Final Preparation for Deployment**
  - Plan the Deployment using the *DVS* software
  - Set Clock Data and Time using the *DVS* software
  - Erase the recorder using the *DVS* software
  - Send deployment commands using the *DVS* software

Visual Inspection and Cleaning

Before connecting the DVS, make a quick visual inspection and cleaning of the components to make sure nothing is damaged. Antifouling paint may be applied to the DVS at this time.

Check the DVS for Damage



Inspect the DVS for damage. There should be no cracks, loose hardware, or peeling surfaces.

Check the 6000-meter DVS system paint for damage. Inspect the end-cap, 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 (blue or white). Be critical in your judgment; the useful life of the DVS depends on it.

Clean the DVS

High resolution temperature sensor (left) and standard TRDI temperature sensor (right)

Before storing or shipping the DVS, 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.

The 6000-meter DVS system temperature sensor is embedded in the transducer head assembly.

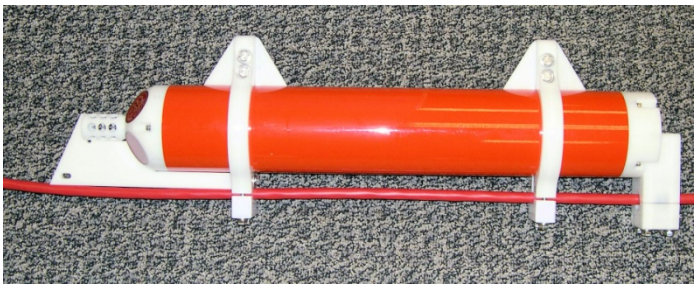
CAUTION. The urethane coating on the transducer faces is easily damaged. Do not use power scrubbers, abrasive cleansers, scouring pads, high-pressure marine cleaning systems, or brushes stiffer than hand cleaning brushes on the transducer faces.

CAUTION. Do not remove the temperature sensor guard. It is not field-replaceable.

NOTE. The high-resolution temperature sensor is optional. It may not be included on your system.

Apply Antifouling Paint

You can use almost any EPA approved anti-fouling paint on the housing or the urethane transducer faces. You do have to be careful to apply an even, thin layer (0.1mm, 4mil per coat) of paint to the urethane faces.



Transducer Faces and Housing

Preparation – clean thoroughly.

Application - Apply one or two coats of antifouling paint at four mils per coat. If applying a second coat, wait at least 12 hours to allow the first coat to dry. One coat lasts one season (3 to 4 months); two coats might last one year.

NOTE. Do not apply antifouling paint to the white Delrin portions of the DVS. The paint will not stick.

Bench Test

The bench-testing process ensures that the DVS is working properly before you put it in the water. The bench-test procedure will involve powered tests that will verify that the DVS's electronics and transducers are functioning.

This Section Covers:

- Setup the DVS
- Test the DVS
- Compass alignment

Setup the DVS

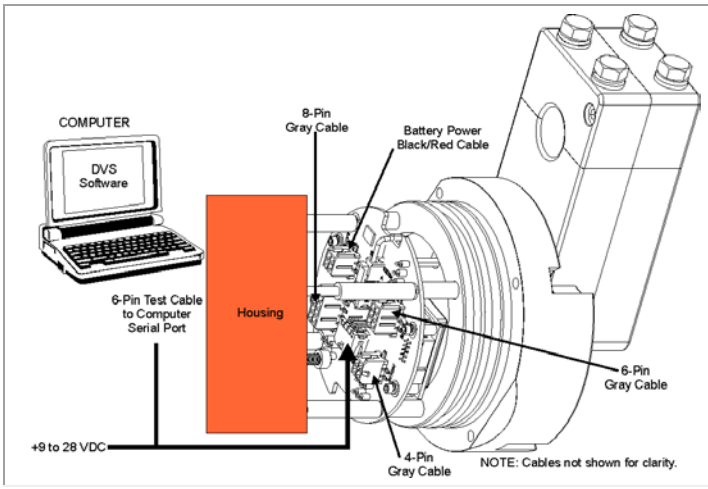
Connect the DVS to a power supply and a computer with the *DVS* software installed. On systems equipped with an IMM, most testing and data downloads are done via the test cable with the end-cap removed and using external power (both to conserve power and because the test cable provides faster communication than does the inductive modem). The DVS with IMM option can be made watertight only when powered internally from the battery pack (see "Seal the DVS for Deployment," page 19).

NOTE. The DVS will select between the battery and the power supply if both are connected. To ensure that the battery is not being used at this time, either disconnect the battery or ensure that the external power supply is supplied at a voltage higher than the batteries are currently able to provide. This can be accomplished by setting the power supply to 24 VDC or by starting the power supply at 9 VDC, and stepping up in 1 V increments until a significant increase in the current draw from the power supply is observed (maximum 28 VDC).

NOTE. The DVS is shipped with the battery pack disconnected for safety. The end cap must be removed and power supplied before any communication is possible with the DVS.

CAUTION. When disconnecting the external power supply, if you do not wish to deploy the DVS immediately, be sure to send the DVS a CZ command to put it to sleep **before** disconnecting it from the external power supply. Verify that it has gone to sleep by observing a significant drop in the current draw prior to disconnecting.

RS-232 Setup



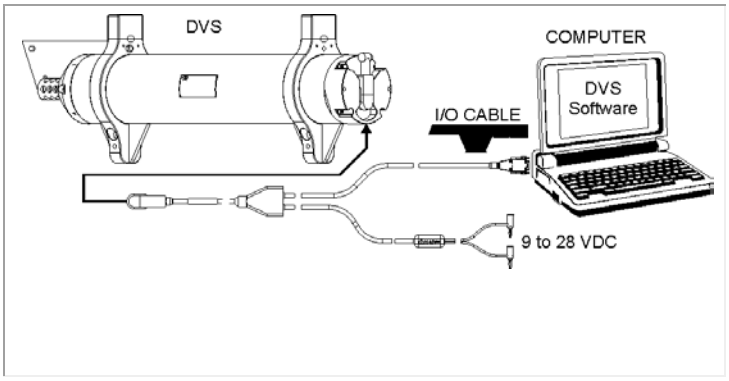
Remove the end-cap far enough to allow access to the cables.

Connect the 6-pin test cable to the End-Cap Interface board.

Attach the test cable to your computer's communication port. The standard communications settings are RS-232, 115200-baud, no parity, 8 data bits and 1 stop bit.

Connect the test cable red/black banana plugs to an external power supply (+ 9 to 28 VDC).

End-Cap with Connector

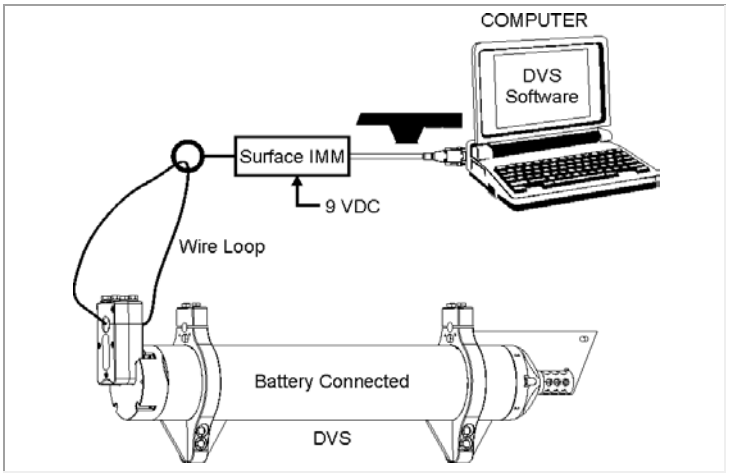


Remove the dummy plug from the end-cap and connect the I/O cable to the DVS end-cap.

Attach the I/O cable to your computer's communication port. The standard communications settings are RS-232, 115200-baud, no parity, 8 data bits and 1 stop bit.

Connect the test cable red/black banana plugs to an external power supply (+ 9 to 28 VDC).

Inductive Modem Setup



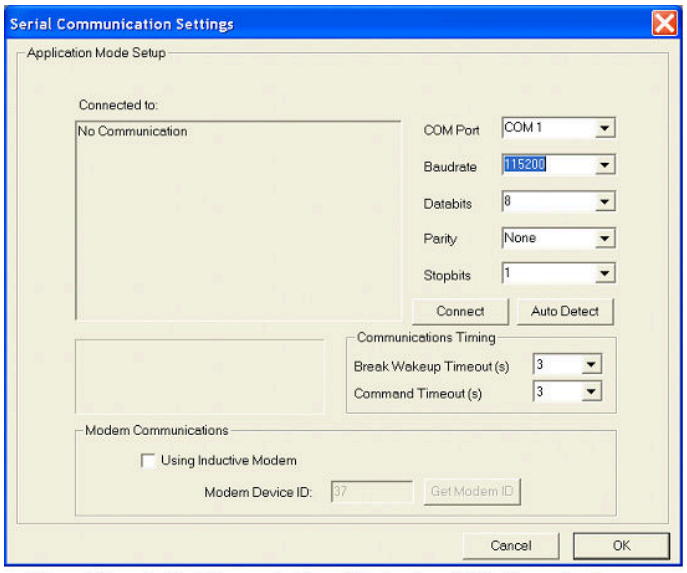
Loop a conductor through the DVS inductive modem and the surface inductive modem (not supplied) connected to a computer.

Power can be supplied either from the battery pack or from an external supply via the test cable. If the DVS is sealed for deployment, then power must be supplied from the battery pack.

Connecting to the DVS

RS-232 via the Test Cable or End-Cap with Connector

Use these next steps to "talk" to the DVS.



Start DVS

Connect and power up the DVS as shown in "Setup the DVS," page 11.

Start the *DVS* software.

At the **DVS Wizard Startup Options** screen, click **Cancel**.

From the **Configure** menu, click **Serial Communications**.

Select the COM port, baud rate, parity, and stop bits that the DVS is connected to. If you are unsure of the setting, use **Auto Detect**.

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DVS
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Firmware Version: 41.xx
```

Click the **Connect** button. You should see the wakeup message appear on the deployment log window.

Click **OK**.

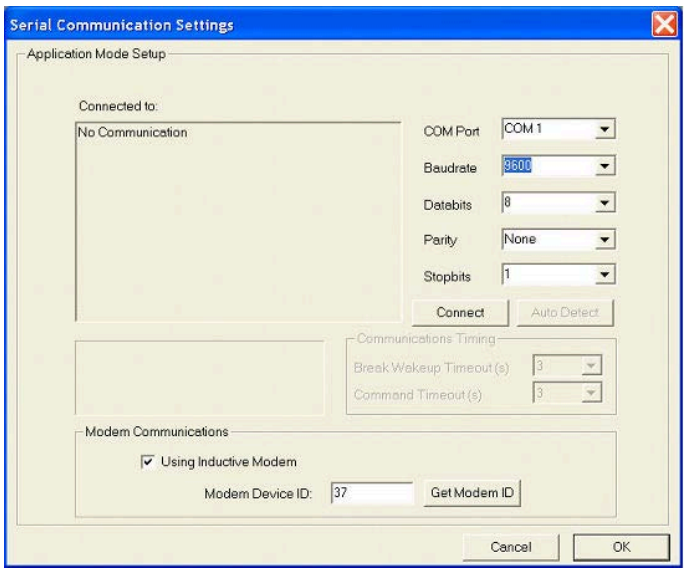
What if the DVS Does Not Respond?

If the DVS does not respond, check the serial port, cables, external power supply, and battery connection. If necessary, refer to the Troubleshooting section in the DVS Operation Manual.

CAUTION. DVS batteries are shipped inside the DVS but not connected. **Connect the battery and seal the DVS before deployment.**

Configure Serial Connection to the Surface IMM

The first step is to configure the serial connection to the surface IMM.



Start DVS

Connect and power up the DVS as shown in "Setup the DVS," page 11.

Start the *DVS* software.

At the **DVS Wizard Startup Options** screen, click **Cancel**.

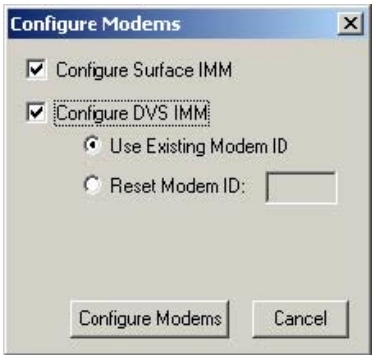
From the **Configure** menu, click **Serial Communications**.

Select the appropriate COM port (i.e. the port that the surface modem is connected to). For the baud rate, select 9600. Serial communications with the IMM's should always be set to 9600 baud. Leave the other settings at their default values.

Select the **Using an Inductive Modem** box and click the **Get Modem ID** button.

Press the **OK** button to close the **Serial Communication Settings** dialog.

NOTE. The inductive modems actually communicate with each other at a baud rate of 1200, and do not support communication with the DVS at baud rates above 9600.



On the **Configure** menu, select **Modems**. Select which modem(s) you wish to configure (i.e. the Surface IMM connected to the serial port and/or the DVS IMM).

If you are configuring the DVS IMM, you have the option of **Use Existing Modem ID**, or **Reset Modem ID** (from 00 to 99).

Press the **Configure Modems** button to start the configuration process.

NOTE. The **DVS Modem ID** that is configured will be applied to the software serial communication settings for future modem communications.

The DVS IMM can only be configured when it is the only device on the line.

The dialog will update with a status bar and information on the configuration steps being run.

The configuration process will take a few minutes to complete. Once the process in completed, a message box will appear letting you know that the selected configuration(s) are completed.

If the modem configuration process does not complete successfully, check the serial connection from the PC to the surface IMM, and the connection to the DVS system (if you are attempting to configure the DVS modem). If the connections look correct and the modem configuration still fails, you will need to test your modem connections. The DVS Operation Manual describes how to verify modem communications.

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Firmware Version: 41.xx
```

From the **Configure** menu, click **Serial Communications**.

Click the **Connect** button. You should see the wakeup message appear on the deployment log window.

Click **OK**.

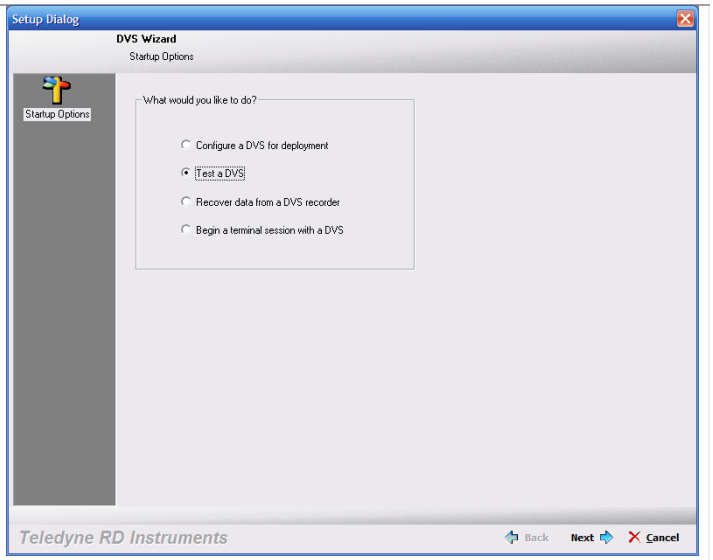
What if the DVS Does Not Respond?

If the DVS does not respond, check the serial port, surface IMM, surface IMM power, wire loop, cables, external power supply, and battery connection. If necessary, refer to the Troubleshooting section in the DVS Operation Manual.

CAUTION. DVS batteries are shipped inside the DVS but not connected. **Connect the battery and seal the DVS before deployment.**

Testing the DVS

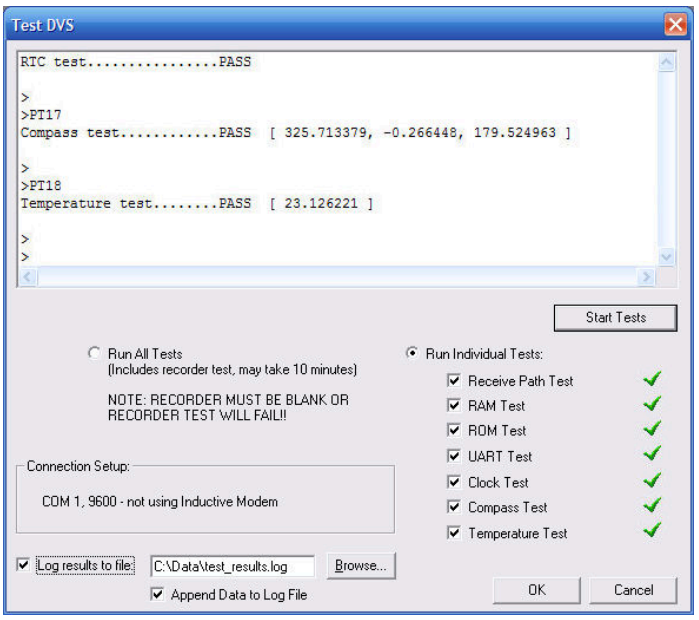
Before deploying the DVS, it is a good idea to make sure that it is working properly. This simple test checks that the DVS is able to communicate with the computer and runs the diagnostic tests.



Connect and power up the DVS as shown in "Setup the DVS," page 11.

Start the *DVS* software.

At the **DVS Wizard Startup Options** screen, click **Test a DVS**. Click **Next**.



On the **Test DVS** screen, select **Run All Tests** (includes the recorder test) or **Run Individual Tests** and select the desired tests.

The results of the test will be saved to the log file (*.log) if the **Log result to file** box is selected.

Click the **Start Test** button. The selected tests will run (see the DVS Operation Manual for details on the test printouts). A green check mark next to the test name indicates the test passed. If a selected test fails, a red X will be placed next to the test name and a dialog box will prompt if you want to continue testing.

Click **OK** to exit the **Test DVS** screen.

NOTE. These tests should be run in the deployed environment to achieve good results.

Compass Calibration

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. You should be aware of the following items:

- We recommend against calibrating the DVS while on a ship. 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 DVS inside the fixture. Depending on the strength and complexity of the fixture's field, the calibration procedure may be able to correct it.

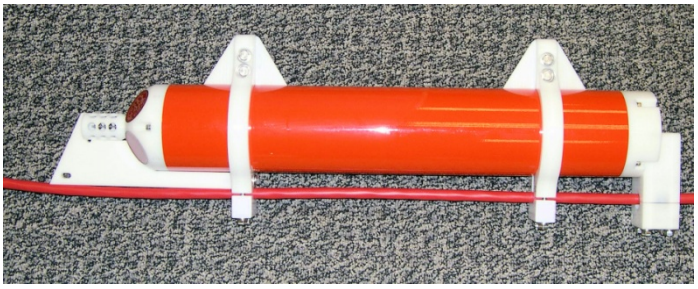
NOTE. Battery replacement induces both single and double cycle compass errors. If the DVS battery module was removed and replaced back in the same orientation, the compass does not require calibration. If the battery core is replaced, you **must** calibrate the compass.

NOTE. No factory calibration was done on the compass in your DVS prior to shipment. It is important to calibrate the compass in an environment that closely approximates how it will be deployed prior to deployment.

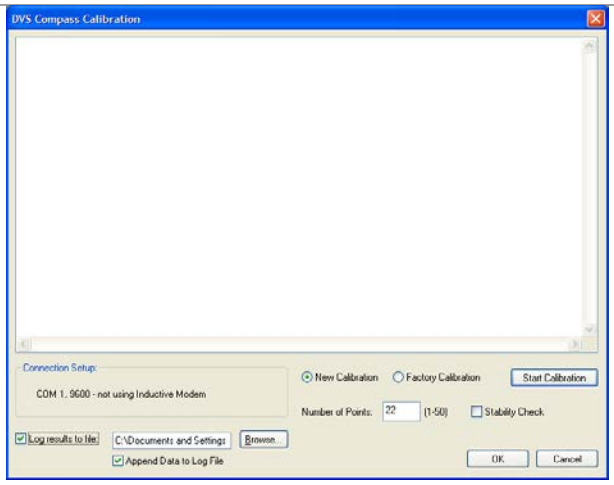
NOTE. TRDI has obtained the best results using a fixture that can rotate the DVS through all three axis. For more information on building your own compass alignment jig, contact TRDI (see "How to Contact Teledyne RD Instruments," page 1).

NOTE. Do not begin the compass calibration procedure while deployed. Doing so will cancel the deployment.

Compass calibration is an automated built-in test that measures how well the compass is calibrated. The procedure measures compass parameters over 20 samples (default). When it has collected data for all required directions, the DVS computes and displays the results.



Mounting hardware should be mounted, and a representative section of mooring line attached during the calibration. The notches on the DVS housing are to ensure that the mooring hardware will mount to a mooring line in a repeatable way.



From the **Tools** menu, click **Calibrate DVS Compass**.

On the **DVS Compass Calibration** screen, select **New Calibration**.

Set the **Number of Points** to 20.

Leave the **Stability Check** box checked if using a fixture or un-checked if calibrating by hand.

Orient the DVS in the direction it will be deployed in: If you will deploy your DVS looking up, calibrate it looking up. If you will deploy it looking down, calibrate it looking down.

Click the **Start Calibration** button.

Fixture (recommended)

Hand Calibration

The DVS must be moved through to each of the following positions, pausing at each step and at every 90 degrees of rotation to allow the TCM5 compass to acquire a sample:

1. Go to +45° pitch
2. Rotate 180° clockwise
3. Go to 0° pitch
4. Go to -45° roll
5. Rotate 180° clockwise
6. Go to 0° roll
7. Go to -45° pitch
8. Rotate 180° counter-clockwise
9. Go to 0° pitch
10. Go to +45° roll
11. Rotate 180° counter-clockwise
12. Go to 0° roll
13. Rotate 360° clockwise

If the compass calibration fails, move to another location and try again.

Click **OK** to exit the **DVS Compass Calibration** screen.

NOTE. Do **not** turn the DVS upside down during the calibration.

Remember to keep the rotations smooth, as a low standard deviation is essential to a successful calibration. Lower standard deviations produce better results.

CAUTION. For hand calibration, protect the DVS by placing it on a soft pad while calibrating the compass.

If performing the calibration face down, pay special attention not to damage the temperature sensor or the Urethane on each beam.

Seal the DVS for Deployment

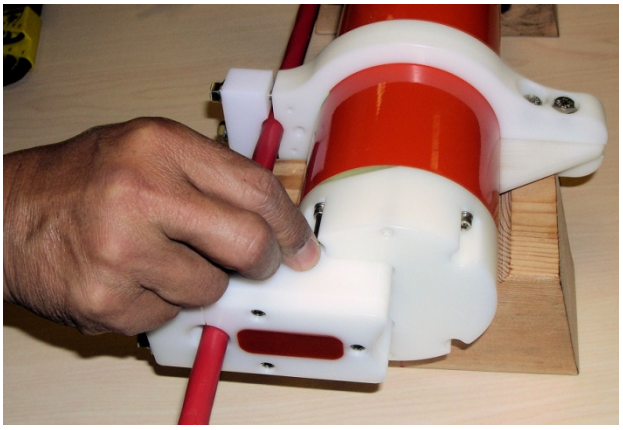
Before you put the DVS into the water, you must prepare it for deployment.

- Install and connect the battery (use the appropriate procedure for standard or high pressure housing)
- Replace the desiccant inside the DVS
- Install new o-rings
- Check all mounting hardware is installed

NOTE. Only the end-cap removal instructions are included in this User's Guide. If you need access to the DVS electronics, the transducer head must be removed. Please refer to the DVS Operation Manual for instructions.

Install and Connect the Battery – Standard 750 Meter DVS

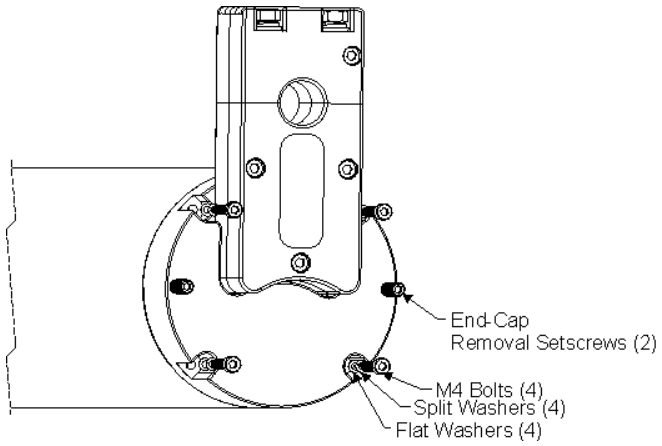
To install the DVS battery pack, do the following steps. Read the DVS Operation Manual for details.



Place the DVS on its side.

Loosen the four M4 retaining bolts holding the end cap sufficiently to allow pressure relief.

CAUTION. Do not remove all retaining bolts entirely. Leaving the bolts partially inserted will help to restrain the end cap in the event of an internal over pressure in the DVS.



Thread the End Cap Removal setscrews in as shown, and slowly turn both to back the end cap out of the housing.

Once any possible over pressure has been released, remove the four M4 retaining bolts.

Gently slide the end-cap and battery assembly away from of the housing just enough to allow the cables to be disconnected.

Disconnect the three gray cables going to the End-Cap Interface Board. These cables are a 4 pin, a 6 pin, and an 8 pin connector to avoid confusion when reconnecting.

Disconnect the tension cord (green wire).

NOTE. The DVS is shipped with the battery pack disconnected for safety.

Loosen the two thumbscrews holding the battery pack onto the posts.

Remove the end plate.

Slide out the used battery pack.

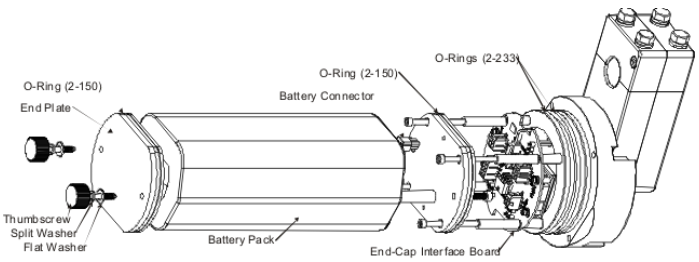
Slide a new battery pack onto the posts. Make sure the power cable is not pinched by the battery pack.

Test the battery pack voltage by measuring across the battery connector. The voltage should be +18 VDC for a new battery pack.

Position the end plate over the post.

Tighten each thumbscrew firmly to hold the battery in place.

CAUTION. Although each thumbscrew has a screwdriver slot, do NOT use any tools to tighten the screws. **Over-tightening can cause the threads to strip.**



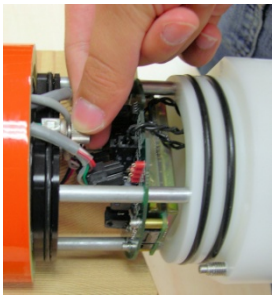
Clean the 2-233 O-ring grooves. Be sure the grooves are free of foreign matter, scratches, indentations, or pitting. Use lint free wipes or a wood scrapper to clean the groove.

Never use Q-tips to clean the O-ring groove; loose fibers or lint can provide a leakage path.

Place a small amount of silicone lube on the O-ring and spread it over the entire O-ring surface. The O-ring should appear "shiny". Wipe off any excess lube.

Place the O-rings in the O-ring groove on the end-cap.

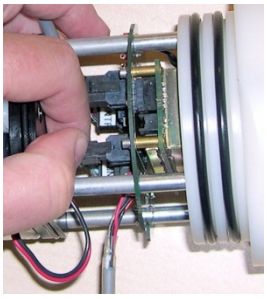
NOTE. The O-rings should be replaced each time the DVS is opened.



Connect the tension cord (green wire).

Connect the three gray cables going to the End-Cap Interface Board.

CAUTION. Although the tension cord thumbscrew has a screwdriver slot, do NOT use any tools to tighten the screw. **Over-tightening can cause the threads to strip.**



Connect the red/black battery pack power cable. This connector is clearly labeled Battery Pack on the End-Cap Interface Board.

CAUTION. When connecting the battery, if you do not wish to deploy the DVS immediately, be sure to send the DVS a CZ command to put it to sleep to save the battery power.

Desiccant bags are used to dehumidify the housing interior.

Remove the new desiccant bag from the plastic zip-lock bag.

Remove the old desiccant bag and install a new one. Place the desiccant bag on top of the End-Cap Interface board.

NOTE. The Desiccant bag should be replaced each time the housing is opened.

Slide the end-cap into the housing making sure that the acoustic modem is aligned with the cable clamps.

Make sure no cables become pinched or that the O-rings fall out of the groove.

Back-out the End-Cap Removal set-screws fully (shown in yellow circle).

Inspect all stainless steel hardware for signs of corrosion. If necessary, replace the End-Cap mounting hardware.

TRDI recommends replacing the hardware if the previous deployment was six months or longer even if the hardware shows no sign of corrosion.

Install all four sets of hardware until "finger-tight."

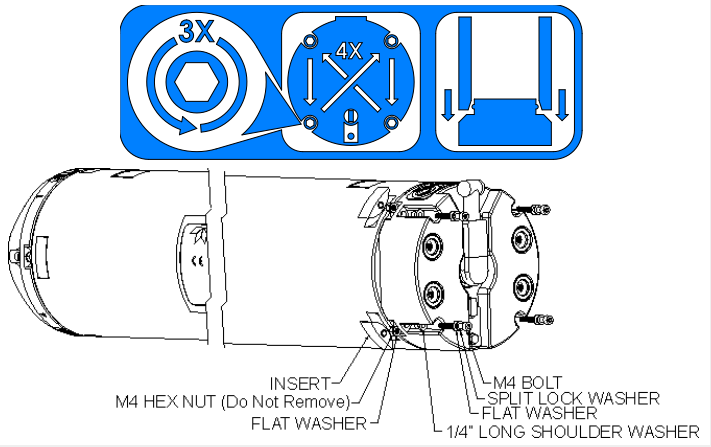
Tighten the bolts in small increments in a "cross" pattern until the split washer flattens out, and then tighten each bolt ¼ turn more to compress the O-rings evenly.

Tighten the bolts to the recommended torque value of 1.2 ± 0.2 Newton-meters (10.62 ± 1.7 pound-inches).

Install and Connect the Battery – High Pressure 6000 Meter DVS

To install the DVS battery pack, do the following steps. Read the DVS Operation Manual for details.

NOTE. The DVS is shipped with the battery pack disconnected for safety.



Place the DVS on its side.

Using an L-wrench only, loosen one of the M4 bolts three turns as shown on the Instruction Label located on the end-cap.

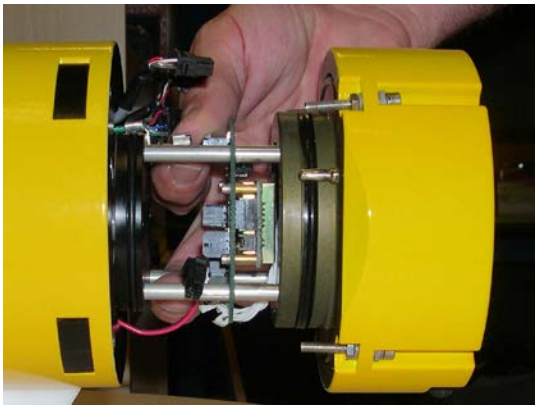
Do not loosen or remove the M4 hex nut.

Move to the next bolt in a crisscross pattern as indicated by the Instruction Label and loosen that bolt three turns.

Observe that the end-cap is parallel to the housing at all times by selecting bolts in a crisscross pattern and **loosen each M4 bolt three turns at a time to back out the end-cap evenly.**

CAUTION: Failure to follow this procedure may cause damage to the DVS housing or end-cap.

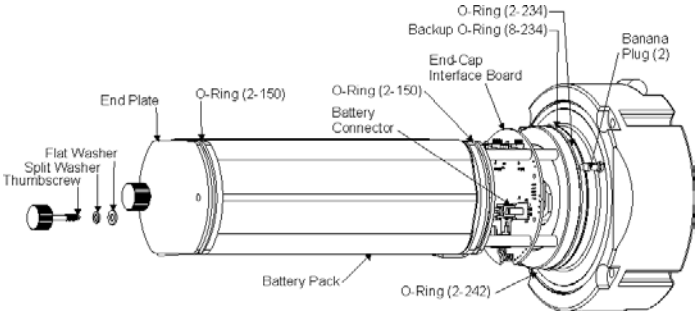
As the bolts are loosened, the end-cap will be backed out away from the housing.



Gently slide the end-cap and battery assembly away from of the housing just enough to allow the cables to be disconnected.

Disconnect the three gray cables going to the End-Cap Interface Board. These cables are a 4-pin, a 6-pin, and an 8-pin connector to avoid confusion when reconnecting.

Disconnect the tension cord (green wire).



Loosen the two thumbscrews holding the battery pack onto the posts.

Remove the end plate.

Slide out the used battery pack.

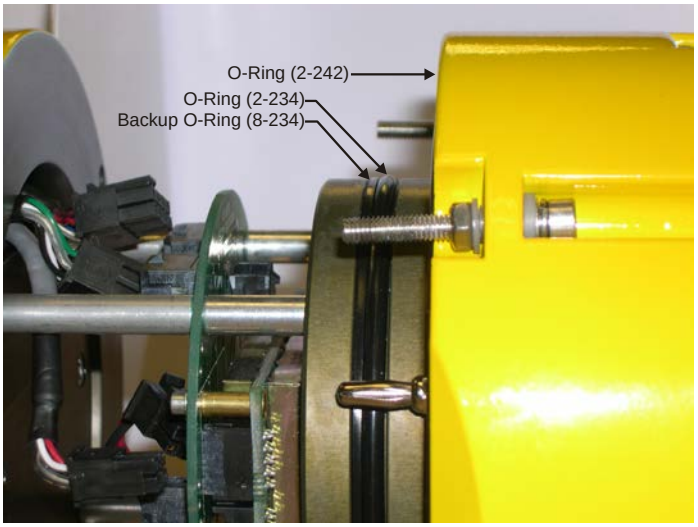
Slide a new battery pack onto the posts. Make sure the power cable is not pinched by the battery pack.

Test the battery pack voltage by measuring across the battery connector. The voltage should be +18 VDC for a new battery pack.

Position the end plate over the post.

Tighten each thumbscrew firmly to hold the battery in place.

Do NOT use any tools to tighten the thumbscrews. **Over-tightening can cause the threads to strip.**



Clean the O-ring grooves. Be sure the grooves are free of foreign matter, scratches, indentations, or pitting. Use lint free wipes or a wood scrapper to clean the groove.

Never use Q-tips to clean the O-ring groove; loose fibers or lint can provide a leakage path.

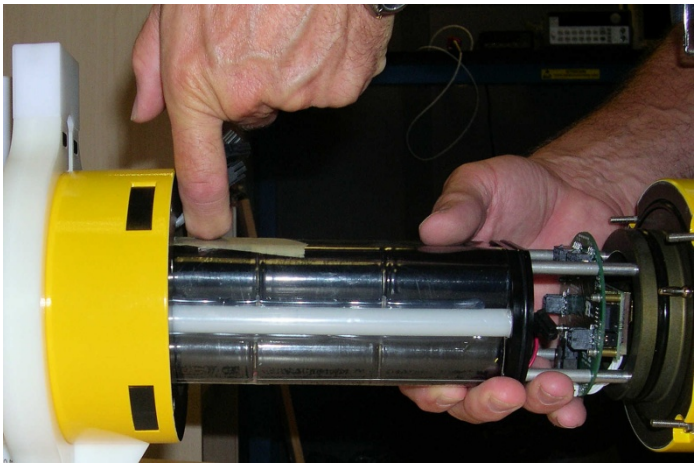
Place a small amount of silicone lube on the O-ring and spread it over the entire O-ring surface. The O-ring should appear "shiny". Wipe off any excess lube.

Place the O-rings in the O-ring groove on the end-cap.

The backup O-ring is installed on 6000-meter high-pressure housing systems in addition to the 2-234 bore O-ring.

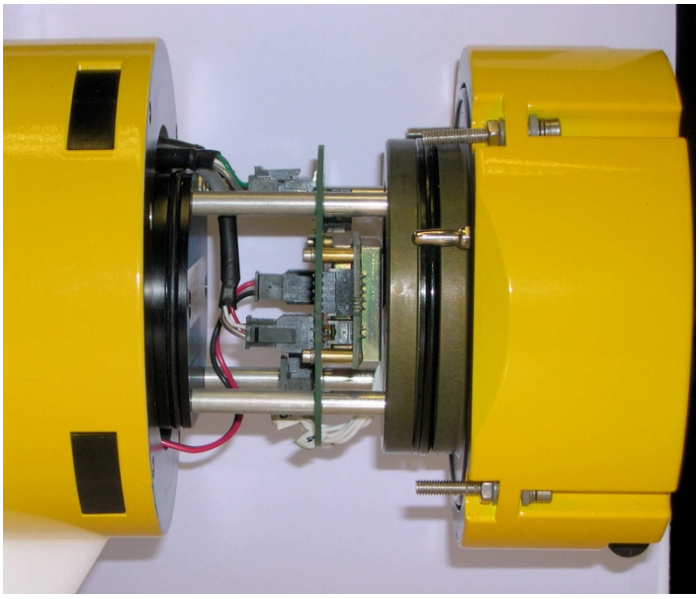
Install the backup O-ring with the cupped side facing the 2-234 bore seal O-ring.

NOTE. The O-rings should be replaced each time the DVS is opened.



Slide the end-cap into the housing making sure that the acoustic modem or end-cap connector is aligned with the cable clamps.

Make sure no cables become pinched or that the O-rings slip out of the groove.



Connect the tension cord (green wire).

Do NOT use any tools to tighten the thumbscrew. **Over-tightening can cause the threads to strip.**

Connect the three gray cables going to the End-Cap Interface Board.

Connect the red/black battery pack power cable. This connector is clearly labeled Battery Pack on the End-Cap Interface Board.

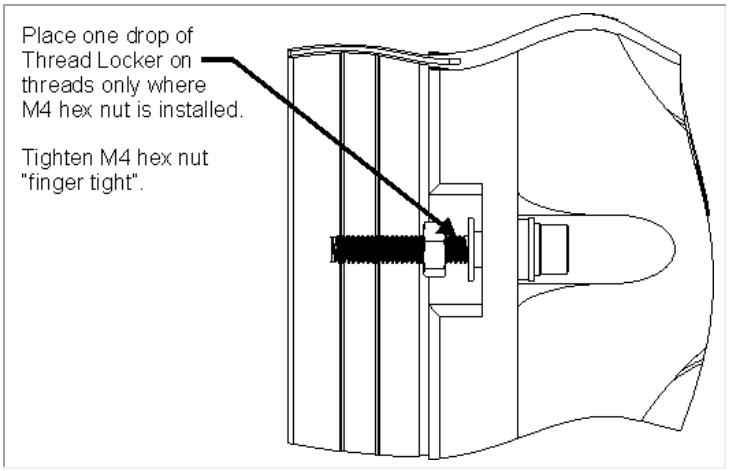
When connecting the battery, if you do not wish to deploy the DVS immediately, be sure to send the DVS a CZ command to put it to sleep to save the battery power.

Desiccant bags are used to dehumidify the housing interior.

Remove the new desiccant bag from the plastic zip-lock bag.

Remove the old desiccant bag and install a new one. Place the desiccant bag on top of the End-Cap Interface board.

The Desiccant bag should be replaced each time the housing is opened.

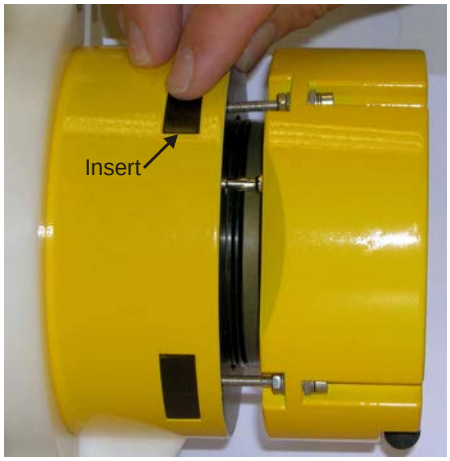


Inspect all stainless steel hardware for signs of corrosion. If necessary, replace the End-Cap mounting hardware.

TRDI recommends replacing the hardware if the previous deployment was six months or longer even if the hardware shows no sign of corrosion.

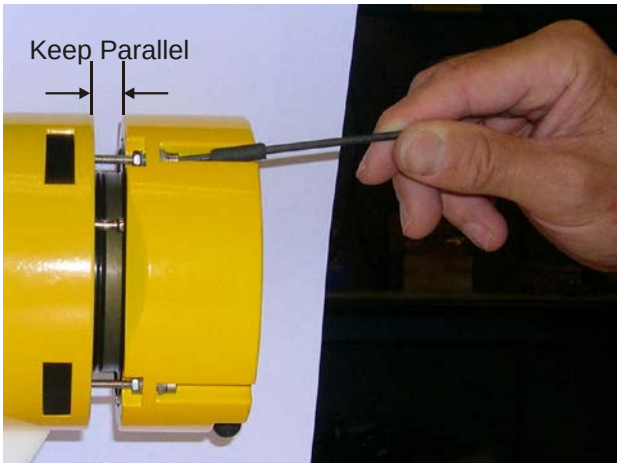
If the hardware is replaced, apply one drop of thread locker to the M4 bolt only where the M4 hex nut is installed. Tighten the M4 hex nut “finger tight”.

Allow the thread locker to cure for 24 hours before deploying the DVS.



Check the inserts are not stripped or worn. Replace as necessary.

Inserts snap into place with the metal thread portion facing the end-cap.



Tighten the bolts to the recommended torque value of 1.2 ± 0.2 Newton-meters (10.62 ± 1.7 pound-inches).

Tighten one M4 bolt three full turns. Move to the next M4 bolt in a "criss-cross" pattern and tighten that bolt three turns. Repeat until all four bolts are tightened.

As the bolts are tightened, the end-cap will seat into the housing.

Observe that the end-cap is parallel to the housing at all times by selecting bolts in a crisscross pattern and **tighten each M4 bolt three turns at a time to seat the end-cap evenly.**

CAUTION. Failure to follow this procedure may cause damage to the DVS housing or end-cap.

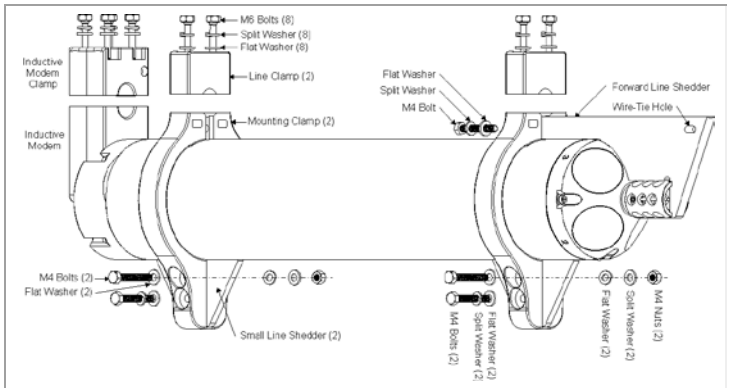
Anodes

High-pressure DVS systems have eight sacrificial zinc anodes (four on the end-cap and four on the transducer head assembly). If the DVS does not have exposed bare metal, properly installed anodes will help protect the DVS from corrosion while deployed.

Read the DVS Operation Manual – Maintenance section for details on anode inspection and replacement.

Install Mounting Hardware

NOTE. Mounting hardware and line shedders are available from Teledyne RD Instruments. Please contact your local sales representative for further information, or if you desire assistance in applying the DVS to your specific situation.



To connect the DVS to the mooring line, do the following.

Install the two mounting clamps and line shedders on the DVS housing.

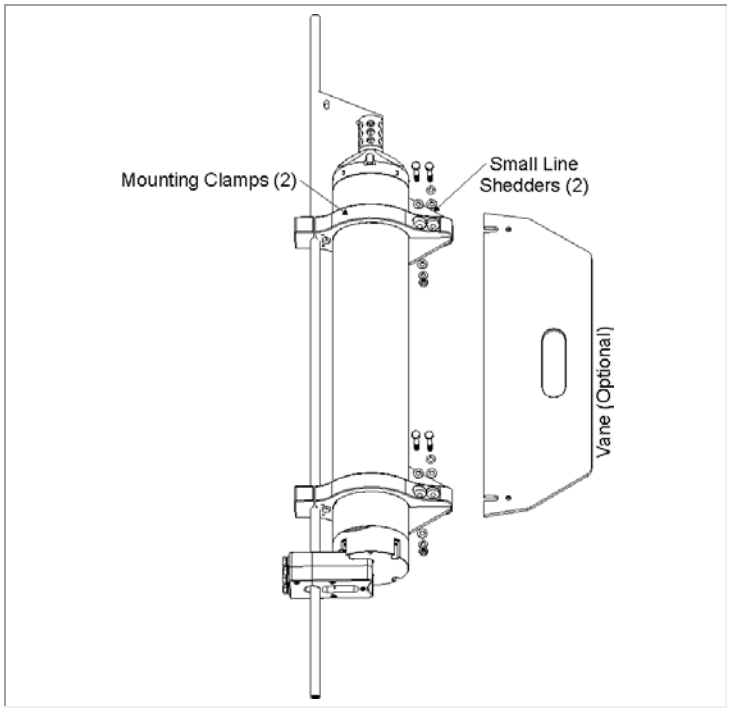
Remove the inductive modem line clamp from the inductive modem.

Clamp the mooring line between all three line clamps.

Install the forward line shedder. Add a wire tie to the forward line shedder to hold the line shedder to the mooring line.

Tighten the M6 hardware for the line clamps to 10.8 ± 1.0 Newton-meters (96 ± 9 pound-inches).

Tighten the M4 hardware for the line shedders to 1.2 ± 0.2 Newton-meters (10.6 ± 1.7 pound-inches).



An optional vane can be attached opposite to the mooring line to help reduce instrument vibration should the mooring line start strumming. To install the vane, do the following.

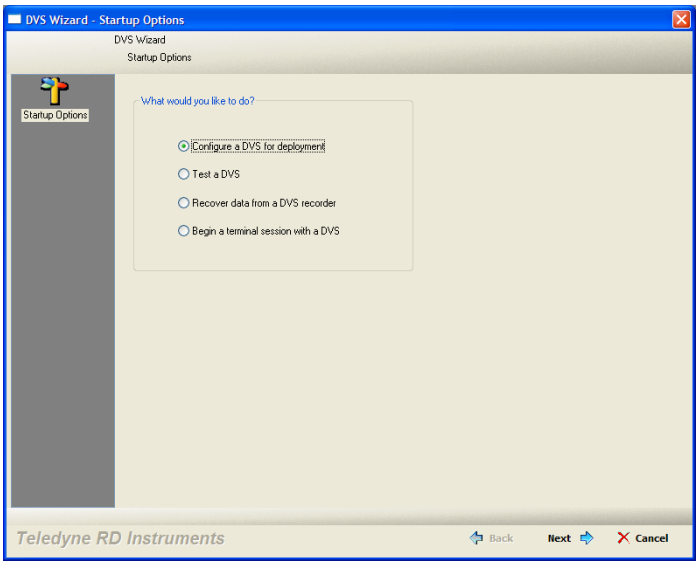
Remove the two small line shedders.

Install the vane using the hardware from the two small line shedders.

Tighten the M4 hardware to 1.2 ± 0.2 Newton-meters (10.6 ± 1.7 pound-inches).

Final Preparation for Deployment

The *DVS* software is designed to create a command file that will be used to set up a DVS for collecting data. In this example, we will use the *DVS* software to develop the command file, and then continue with the deployment and recovery of data.



Connect and power up the DVS as shown in "Setup the DVS," page 11.

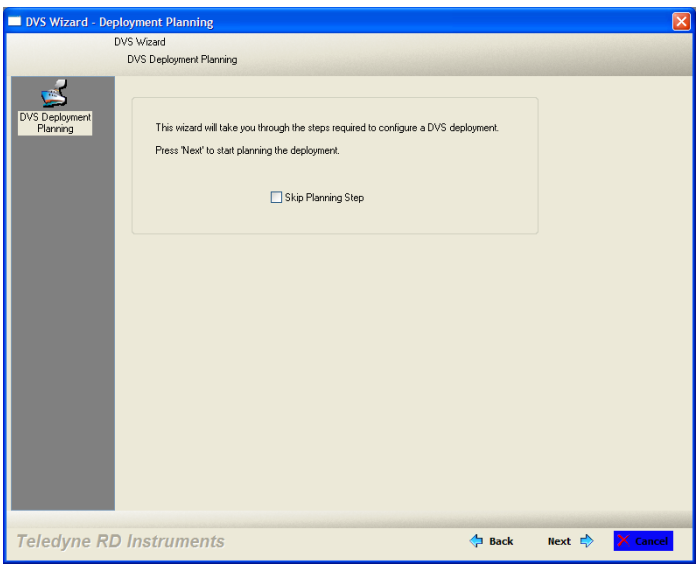
Start the *DVS* software.

At the **DVS Wizard Startup Options** screen, click **Configure a DVS for a New Deployment.**

Click **Next**.

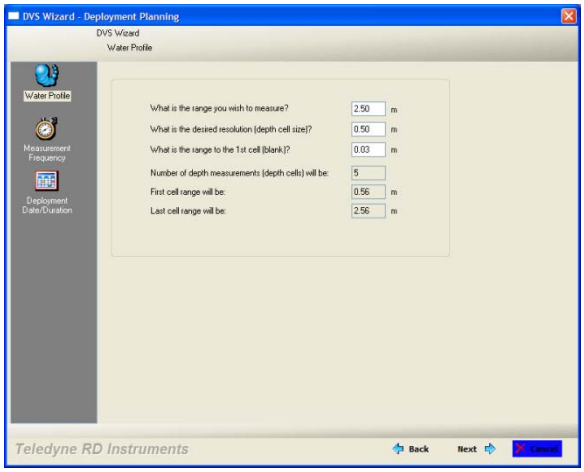
Planning the Deployment

Use the following steps to create the command file using the *DVS* software.



The first step is planning. Make sure the **Skip Planning Step** box is <u>not</u> checked.

Click **Next**.



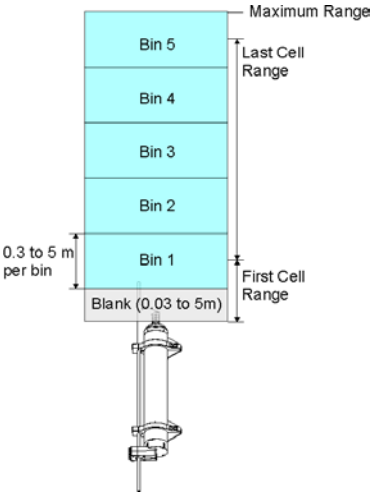
Select the depth range (1 to 5 meters) you wish to measure.

Set the resolution (depth cell size) to between 0.03 to 5.0 meters. A larger depth cell (bin) size decreases the standard deviation, but shallow water situations may need to use small depth cells (bins) to get more data points.

Set the range to the 1st cell (blank) to between 0.03 (default) to 5 meters.

The *DVS* software will automatically set the number of depth cells (bins) and show the first and last cell range.

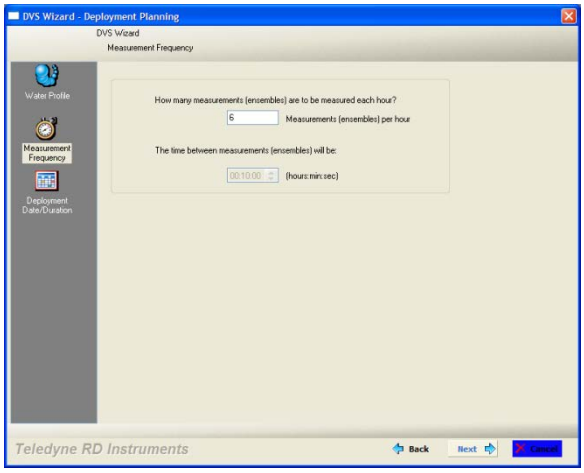
Click **Next**.



First Cell Range – The range from the transducer face to the middle of the first depth cell (bin). The depth cell (bin) size and the WF (blank) command in the command file primarily affect where it is located.

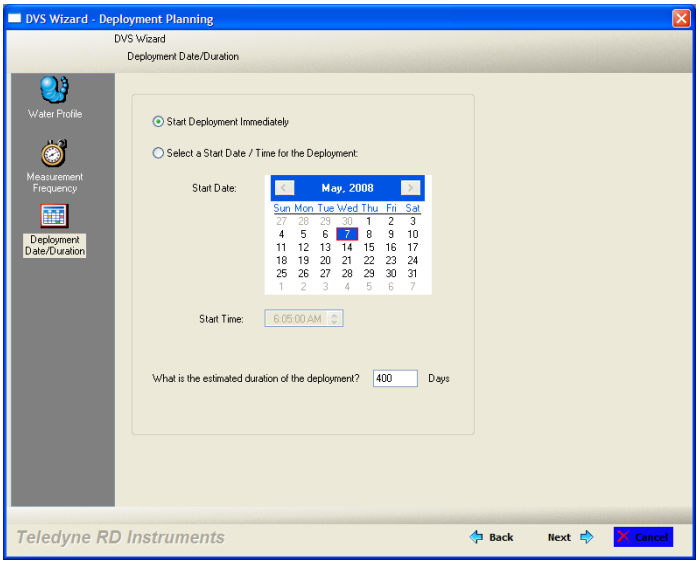
Last Cell Range – The last depth cell range is determined from the number of depth cells (bins), depth cell size, and first depth cell range.

Max Range – The maximum profiling range (see DVS Deployment Settings, page 31) is dependent on the DVS frequency, water salinity, water temperature, and the depth of the DVS. A warning message will appear if the maximum range exceeds 6 meters.



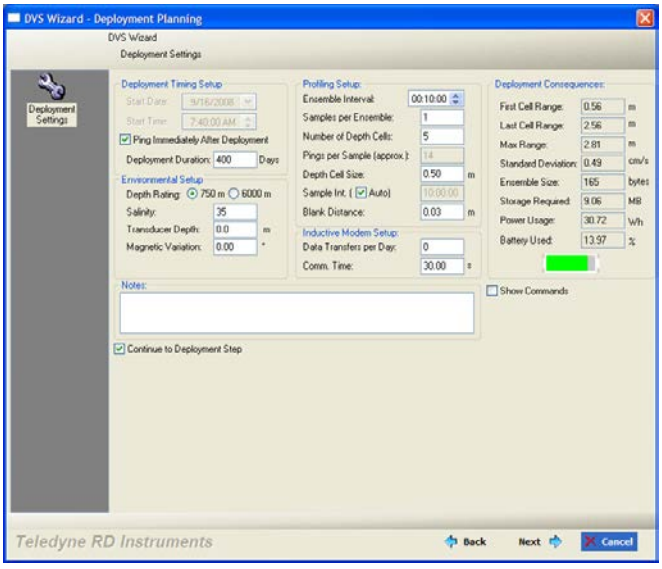
Select how many ensembles per hour you want to record. The *DVS* software will automatically set the time between ensembles.

Click **Next**.



Enter the expected duration of the DVS deployment from the time of the first water profiling ping (either immediately or first ping date/time. This duration *does not* produce a command to instruct the DVS to stop data collection; it is for estimating the following *consequences*: Battery/Power usage and Storage required.

Click **Next**.



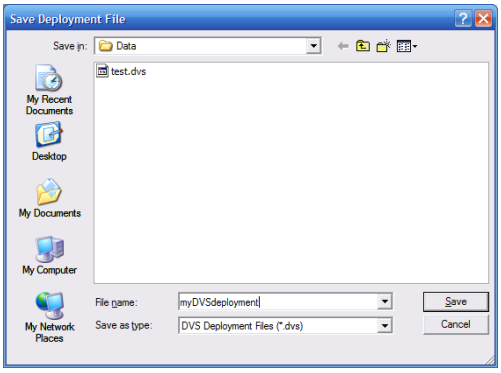
The **DVS Deployment Settings** screen opens using the settings you selected with the wizard.

Review the **Profiling Setup** and **Deployment Consequences**.

When you are satisfied with the setup, make sure the **Continue to Deployment Step** box is selected.

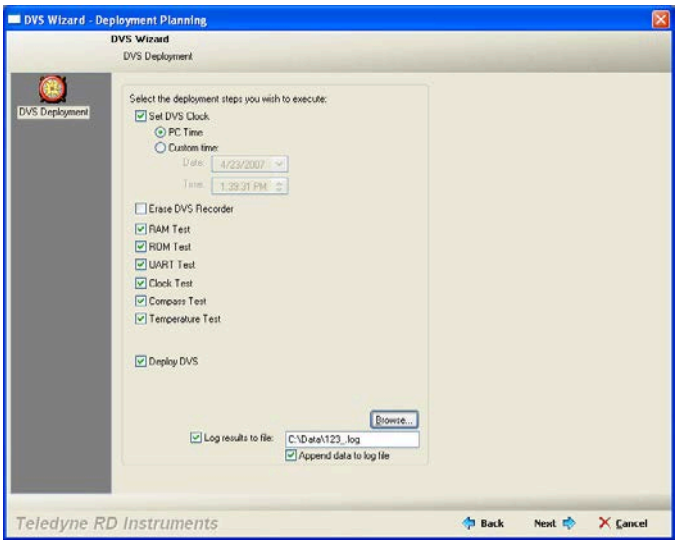
Click **Next**.

NOTE. Any step beyond this point requires communication with a DVS. If a DVS is not available, you can save this configuration for later use by un-checking the **Continue to Deployment Step** check box and clicking **Next**. Otherwise, you will be prompted to save the deployment file generated here, and will proceed to configuring the DVS for deployment.



Name the deployment file and click **Save** to save the deployment file. The *DVS* software will automatically add the extension **.dvs* to the file.

Set Clock and Erase Recorder



By default, the **Set DVS Clock**, all tests, and the **Deploy DVS** box are selected.

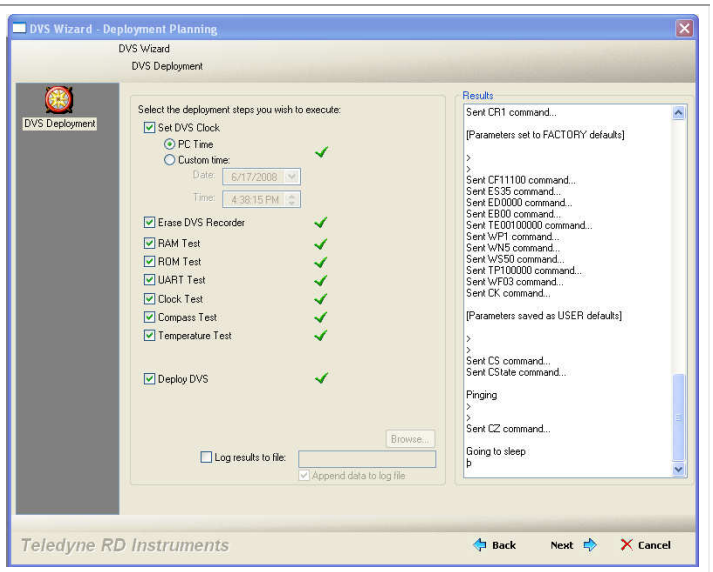
Check the **Erase DVS Recorder** box if the recorder needs to be erased (not selected by default to prevent loss of data).

Select the **Log results to file:** check box and enter a file name using the **Browse** button.

Click **Next**.

Send Deployment Commands to the DVS

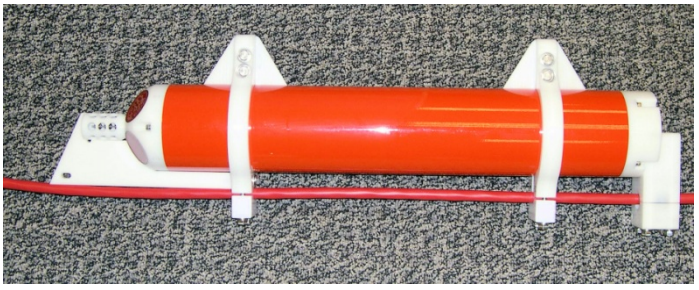
This final step will send the command file to the DVS and configure the instrument for the deployment.



The **Result**s box will open and display the communications to the DVS in real time as the steps are run.

Verify that all tests passed (green checkmark) and the last command sent (CState) returns Pinging.

Click the **Finish** button to exit the DVS wizard.



Once the commands have been sent to the DVS, proceed as follows.

- Disconnect the test I/O cable and verify the DVS is sealed and ready for deployment (see “Seal the DVS for Deployment,” page 19).
- Deploy the DVS.

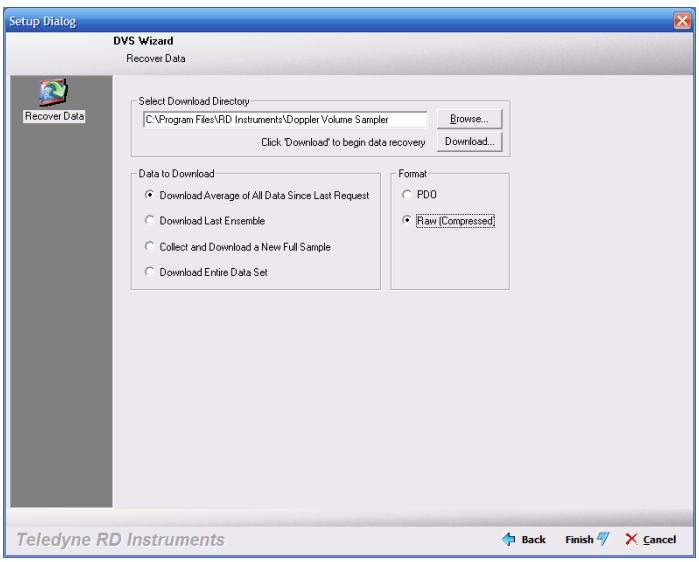
Getting Data during the Deployment

The DVS unit allows communication with the outside world without interrupting the data acquisition schedule. There are three special ways to collect data from a DVS that is deployed and gathering data autonomously. These three are:

- **Collect Average** – This command returns the average of all ensembles collected since the last time the command was sent.
- **Collect Last Ensemble** – This commands the DVS to return the most recently recorded ensemble.
- **Collect One Sample** – This commands the DVS to gather an additional sample right now and send it back (this sample is not recorded - so if it gets lost, it's gone). If a sample is requested that will interfere with a preprogrammed sample (within two seconds), then the DVS will send an error message.

NOTE. When using these commands via the inductive modem, it is important to follow with a CZ command after successful execution of this command. The CZ command will force the DVS to sleep immediately; otherwise, the IMM will keep the DVS awake for its time-out window of 2 to 3 minutes, which will drain the battery much sooner than the planning software would indicate.

Collect Average



Start the *DVS* software.

At the **DVS Wizard Startup Options** screen select **Recover Data from a DVS Recorder**.

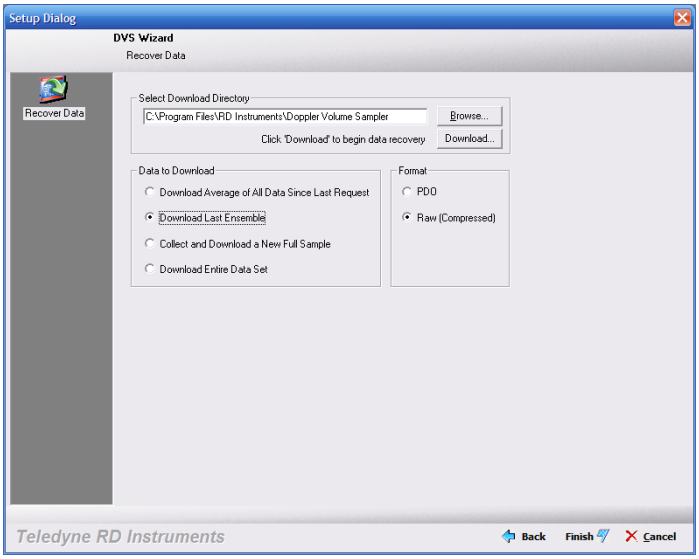
Browse to an appropriate directory for the download.

On the **Data to Download** section, select **Download Average of all Data Since Last Request**.

Select the **Raw (Compressed)** data format.

Click the **Download…** button to begin downloading data.

Collect Last Ensemble



Start the *DVS* software.

At the **DVS Wizard Startup Options** screen select **Recover Data from a DVS Recorder**.

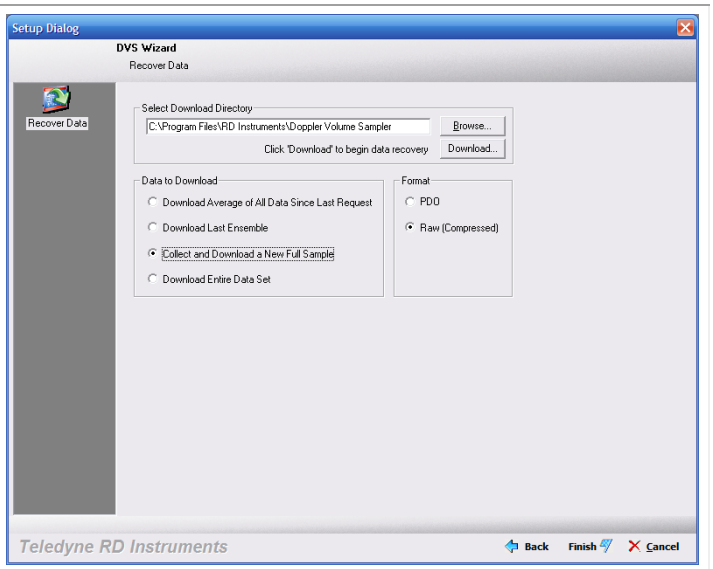
Browse to an appropriate directory for the download.

On the **Data to Download** section, select **Download Last Ensemble**.

Select the **Raw (Compressed)** data format.

Click the **Download…** button to begin downloading data.

Collect One Sample



Start the *DVS* software.

At the **DVS Wizard Startup Options** screen select **Recover Data** from a DVS Recorder.

Browse to an appropriate directory for the download.

On the **Data to Download** section, select **Collect and Download a new Full Sample**.

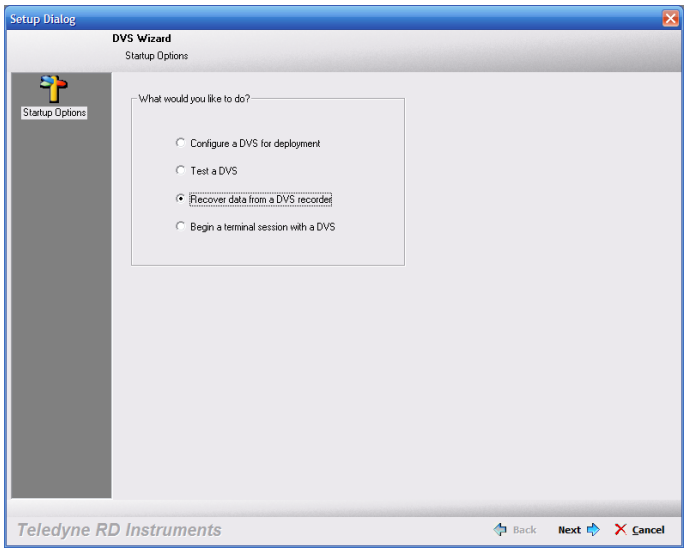
Select the **Raw (Compressed)** data format.

Click the **Download…** button to begin downloading data.

Recover Entire Data Set from DVS

Once you have recovered the DVS, you should clean the DVS exterior (see "Visual Inspection and Cleaning," page 9). Use the *DVS* software to recover the data once the DVS is clean and dry.

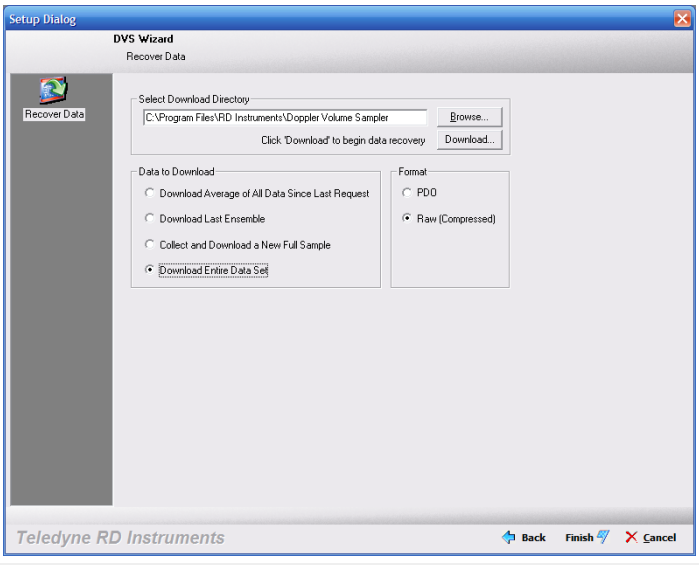
NOTE. It is highly recommended to use the test I/O cable and increase the baud rate to 115200 BAUD to reduce the download time. Use external power to save battery power.



Connect and power up the DVS as shown in "Setup the DVS," page 11.

Start the *DVS* software.

At the **DVS Wizard Startup Options** screen, select **Recover Data from a DVS Recorder**.



Browse to an appropriate directory for the download.

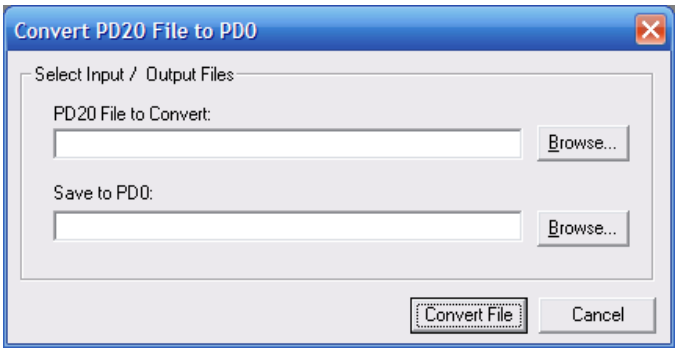
On the **Data to Download** section, select **Download Entire Data Set**.

Select the **Raw (Compressed)** data format.

Click the **Download…** button to begin downloading data.

Convert Raw Data to PD0 Format

The PD20 raw data format is a compressed file format that is not readable by *WinADCP*. To convert the PD20 data to TRDI standard PD0 format, do the following.



Recover the raw PD20 (compressed data) from the DVS recorder (see "Recover Entire Data Set from DVS," page 36).

On the **Tools** menu, select **Convert PD20 to PD0**.

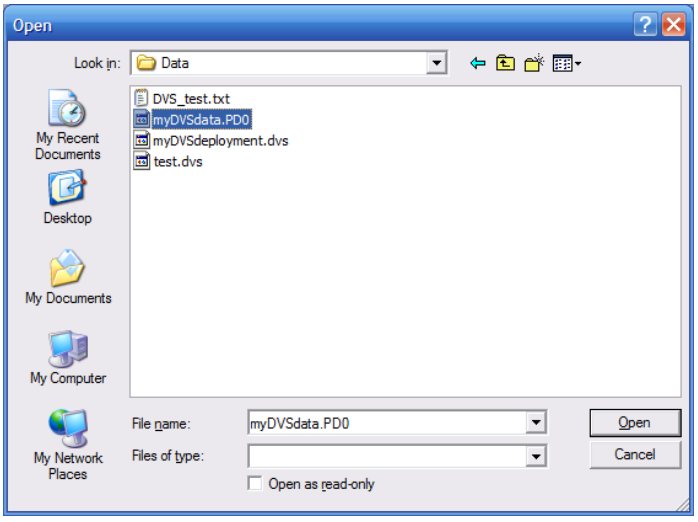
Use the **Browse** button to locate the PD20 file to convert.

Click **Browse** to select a folder and file name for the PD0 file. Click **Save**.

Click the **Convert File** button to begin the conversion.

Viewing Data with WinADCP

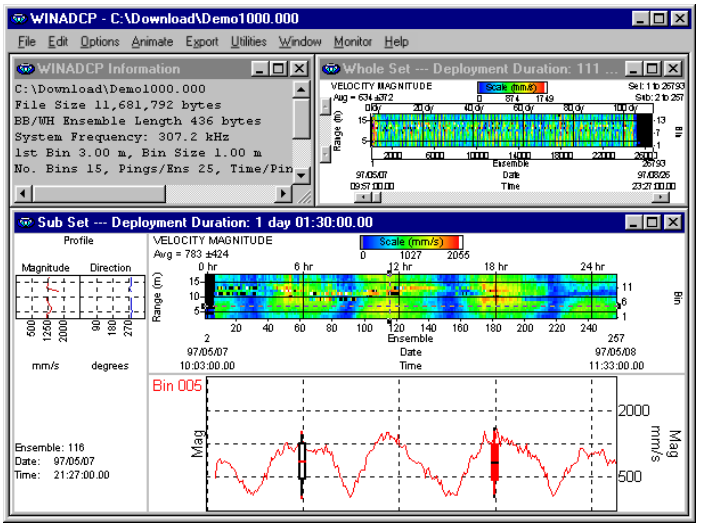
Use *WinADCP* to view color contour and time-series plots of data collected with a DVS in real-time or playback data collected with a DVS.



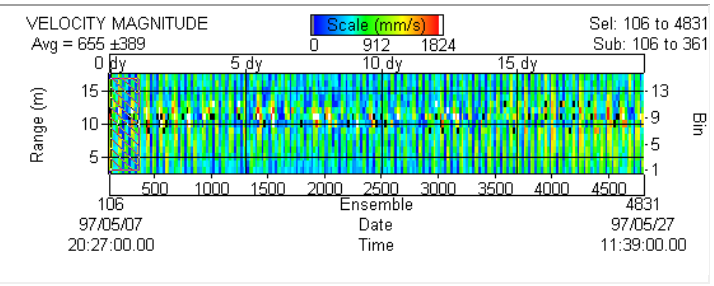
Start *WinADCP.*

On the **File** menu, click **Open**.

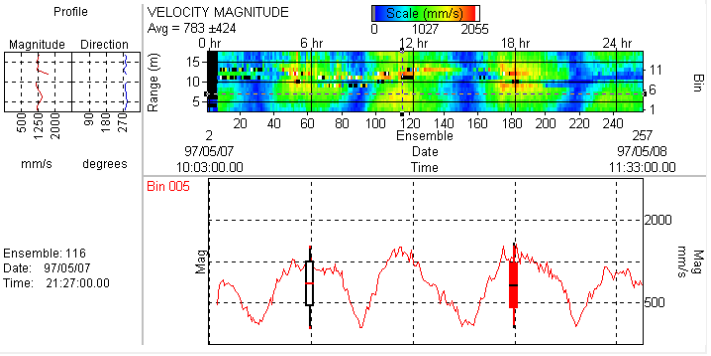
Select the PD0 data file created with the *DVS* software.



WinADCP has two main graphic display forms. The form located in the upper right portion of the screen is called the **Whole Set**. The form located across the bottom half of the display is called the **Sub Set**. Each of these forms displays a portion of the entire data set as a color contour. In addition to the color contour, **Sub Set** displays the user selected **Profile**, **Series**, and **Ancillary** data.



The **Whole Set** form is displayed in the upper right-hand portion of *WinADCP*. When a file containing a Binary Output Data Format is opened, the entire set of the selected data type is displayed as a color contour located within the **Whole Set** form.



By holding down the **Spacebar** and then pressing the **Left** mouse button, the user can drag the mouse to select a portion of the entire data set. When the mouse button is released, the selected portion of the **Whole Set** is marked by a blinking box outline. The blinking box outlines a set of data called the **Selected Set**.

Where to Find More Information

Congratulations! You have completed the DVS User's Guide. For more detailed information about the DVS, see the following sections in the DVS Operation Manual.

Installation. Use this section to plan your installation requirements. This section includes specifications and dimensions for the DVS (including outline installation drawings).

Maintenance. This section covers DVS maintenance. Use this section to make sure the DVS is ready for a deployment.

Test. Use this section to test the DVS.

Troubleshooting. This section includes a system overview and how to troubleshoot the DVS. If the DVS 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 contains a reference for all commands and output data formats used by the DVS.

Technical Support

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

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NOTES