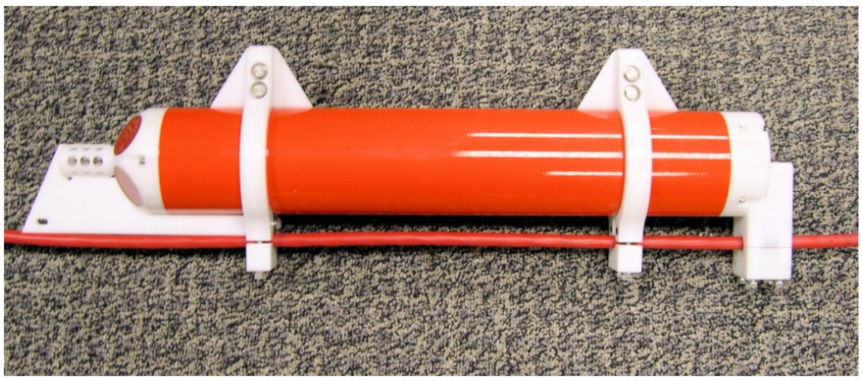
Doppler Volume Sampler
(DVS^{TM})
Operation Manual



P/N 95B-6035-00 (January 2009)

TELEDYNE
RD INSTRUMENTS
A Teledyne Technologies Company

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DVS™ Operation Manual

1 Introduction

Thank you for purchasing a Teledyne RD Instruments (TRDI) Doppler Volume Sampler[1] (DVS™). This Operation Manual is designed to help DVS users to get familiar with their system.

1.1 How to Contact Teledyne RD Instruments

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

Teledyne RD Instruments

14020 Stowe Drive
Poway, California 92064

Phone +1 (858) 842-2600

FAX +1 (858) 842-2822

Sales – rdisales@teledyne.com

Field Service – rdifs@teledyne.com

Teledyne RD Instruments Europe

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

Phone +33(0) 492-110-930

FAX +33(0) 492-110-931

Sales – rdie@teledyne.com

Field Service – rdiefs@teledyne.com

Client Services Administration – rdicsadmin@teledyne.com
Web: http://www.rdinstruments.com
24 Hour Emergency Support +1 (858) 842-2700

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

1.2 Notice of Compliance

1.2.1 Date of Manufacture

China RoHS requires that all Electrical and Electronic Products are marked with a Date of Manufacture. This is the starting point for the Environmental Friendly Use Period, described below.

1.2.2 Environmental Friendly Use Period (EFUP)

Per SJ/T 11364-2006 – Product Marking, the EFUP is defined as the time in years in which hazardous/toxic substances within Electrical and Electronic Products (EIP) will not, under normal operating conditions, leak out of the Product, or the Product will not change in such a way as to cause severe environmental pollution, injury to health, or great damage to property. TRDI has determined the Environmental Friendly Use Period shall be Ten (10) years.

The purpose of the marking is to assist in determining the restricted substance content, recyclability, and environmental protection use period of our covered products, as required in Chinese law, and does not reflect in any way the safety, quality, or warranty associated with these TRDI products.

Some homogenous substance within the EIP contains toxic or hazardous substances or elements above the requirements listed in SJ/T 11363-2006. These substances are identified in Table 1.

1.2.3 WEEE

The mark shown to the left is in compliance with the Waste Electrical and Electronic Equipment Directive 2002/96/EC (WEEE).

This symbol indicates the requirement NOT to dispose the equipment as unsorted municipal waste, but use the return and collection systems according to local law or return to one of the TRDI facilities below.

Teledyne RD Instruments USA
14020 Stowe Drive
Poway, California 92064

Teledyne RD Instruments Europe
2A Les Nertieres
5 Avenue Hector Pintus
06610 La Gaude, France

Teledyne RD Technologies
1206 Holiday Inn Business Building
899 Dongfang Road, Pu Dong
Shanghai 20122
China

1.2.4 CE

This product complies with the Electromagnetic Compatibility Directive 89/336/EEC, 92/31/EEC. The following Standards were used to verify compliance with the directives: EN 61326(1997), A1(1998), A2(2001) – Class “A” Radiated Emissions.

1.2.5 Material Disclosure Table

In accordance with SJ/T 11364-2006, the following table disclosing toxic or hazardous substances contained in the product is provided.

Table 1: Toxic or Hazardous Substances and Elements Contained in Product

零件项目(名称) Component Name	有毒有害物质或元素 Toxic or Hazardous Substances and Elements					
	铅 Lead (Pb)	汞 Mercury (Hg)	镉 Cadmium (Cd)	六价铬 Hexavalent Chromium (Cr^{6+})	多溴联苯 Polybrominated Biphenyls (PBB)	多溴二苯醚 Polybrominated Diphenyl Ethers (PBDE)
换能器装配件 Transducer Assy.	X	O	O	O	O	O
接收机电路板 Receiver PCB	X	O	O	O	O	O
数据处理器电路板 DSP PCB	X	O	O	O	O	O
输入输出口电路板 PIO PCB	X	O	O	O	O	O
通讯接口板 Personality Module	X	O	O	O	O	O
机体装配件 Housing Assy.	O	O	O	O	O	O
电池组 Battery Pack	X	O	O	O	O	O
底座装配件 End-Cap Assy.	X	O	O	O	O	O
底座接口电路板 End-Cap Intf. PCB	X	O	O	O	O	O
外接电缆 External Cables	X	O	O	O	O	O
水下专用电缆 Underwater Cable*	X	O	O	O	O	O
专用装运箱和泡沫塑料垫 Shipping Case w/Foam	O	O	O	O	O	O

O: 表示该有毒或有害物质在该部件所有均质材料中的含量均在SJ/T 11363-2006 标准规定的限量要求以下。
O: Indicates that the toxic or hazardous substance contained in all of the homogeneous materials for this part is below the limit required in SJ/T 11363-2006.
X: 表示该有毒或有害物质至少在该部件的某一均质材料中的含量超出SJ/T 11363-2006 标准规定的限量要求。
X: Indicates that the toxic or hazardous substance contained in at least one of the homogeneous materials used for this part is above the limit requirement in SJ/T 11363-2006.

* Optional

1.3 Getting Started

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

The DVS Operation Manual includes the following sections:

- **Introduction**. This section is an overview of the DVS system.
- **Installation**. Use this section to assemble and install the DVS on a mooring line. 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**. These sections contain a reference for all commands and output data formats used by the DVS.

The DVS User's Guide includes:

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

The Documentation CD includes:

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

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

1.4 Conventions Used in Manuals

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

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

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

```
DVS
RD Instruments (c) 2006
All rights reserved.
Firmware Version: 41.xx
>
```

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

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

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

1.5 DVS Care

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

1.5.1 General Handling Guidelines

- Never set the DVS transducer on a hard or rough surface. **The urethane faces may be damaged.**
- Do not expose the transducer faces to prolonged sunlight (24 hours or more). **The urethane faces may develop cracks.** Cover the transducer faces on the DVS if it will be exposed to sunlight.
- Do not store the DVS in temperatures over 60 degrees C or under -25 degrees C. **The urethane faces (and some electronic components) may be damaged.**
- Do not lift or support a DVS by the thermistor guard or line shedding inserts. **The guard and/or shield may break free, causing the DVS to drop.**
- Do not connect or disconnect the cables with power applied. When you connect the cable with power applied, you may see a small spark. **The connector pins may become pitted and worn.**

1.5.2 Battery Guidelines

- 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. **Batteries stored for more than 12 months should NEVER be used!**

1.5.3 Assembly Guidelines

- Read the Maintenance section for details on DVS re-assembly. Make sure the housing assembly O-rings stay in their grooves when you re-assemble the DVS. Tighten the hardware as specified. **Loose, missing, stripped hardware, or a damaged O-ring can cause the DVS transducer to flood.**
- Do not scratch or damage the O-ring surfaces or grooves on the transducer. **If scratches or damage exists, they may provide a leakage path and cause the DVS to flood.** Do not risk a deployment with damaged O-ring surfaces.
- Vent the system before opening by loosening the hardware on the housing. **If the DVS flooded, there may be gas under pressure inside the housing.**

1.5.4 Deployment Guidelines

- Read the DVS User's Guide and the DVS Software User's Guide. **These guides will help you learn how to use the DVS.**
- DVS batteries are shipped inside the DVS but not connected. **Connect the battery and seal** the DVS before deployment.
- Align the compass whenever the battery is replaced. **Ferromagnetic materials affect the compass.**

1.6 System Overview

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

The DVS assembly contains the transducer ceramics and electronics. The standard acoustic frequency is 2400 kHz. See Outline Installation Drawings for dimensions and weights.

Transducer Assembly – The DVS electronics and transducer ceramics are mounted to the transducer assembly. 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.

Thermistor with Guard – The optional high resolution thermistor provides extremely accurate temperature data to the DVS. The thermistor is an OEM version of the Sea-Bird Electronics SBE38. A plastic guard protects the sensor. See DVS Models and Options for the thermistor options.

End-Cap – The End Cap holds either an underwater electrical connector or an underwater-inductive-modem mooring-line clamp/interface (see DVS Models and Options for the end-cap options). 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 - 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 IMM 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, for a nominal voltage level of 18 VDC.

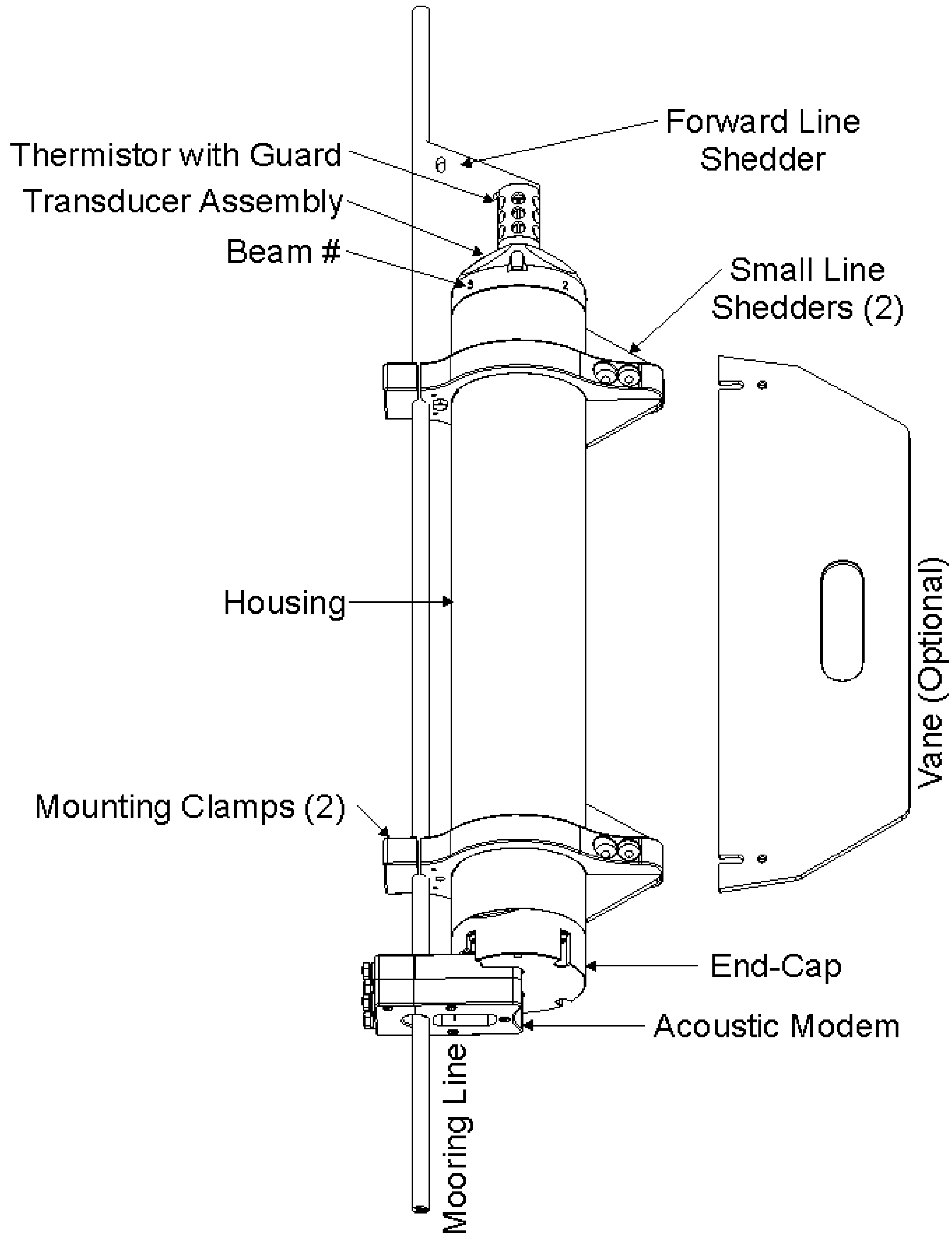


Figure 1. DVS Overview

1.7 DVS Models and Options

The following section explains the different models and options available for DVS systems.

- The DVS can be configured either with the Sea-Bird thermistor or with our standard TRDI thermistor. Depending on what type of temperature sensor is used, the Forward Line Shedder will match the temperature sensor outline (see Figure 2). The thermistor is used to measure the water temperature for speed-of-sound calculations and the water temperature data is available in the output data.

> **NOTE.** The TRDI thermistor is small enough to be embedded in the transducer head assembly and therefore does not require the thermistor guard.

- The end cap can be configured with either the inductive modem (IMM) or with an underwater connector, but not both (see Figure 3).
- The DVS is available as a standard 750 meter system or as a high pressure system capable of deployments to 6000 meters.
- An optional vane can be attached opposite to the mooring line to help reduce instrument vibration should the mooring line start strumming (see Figure 1).

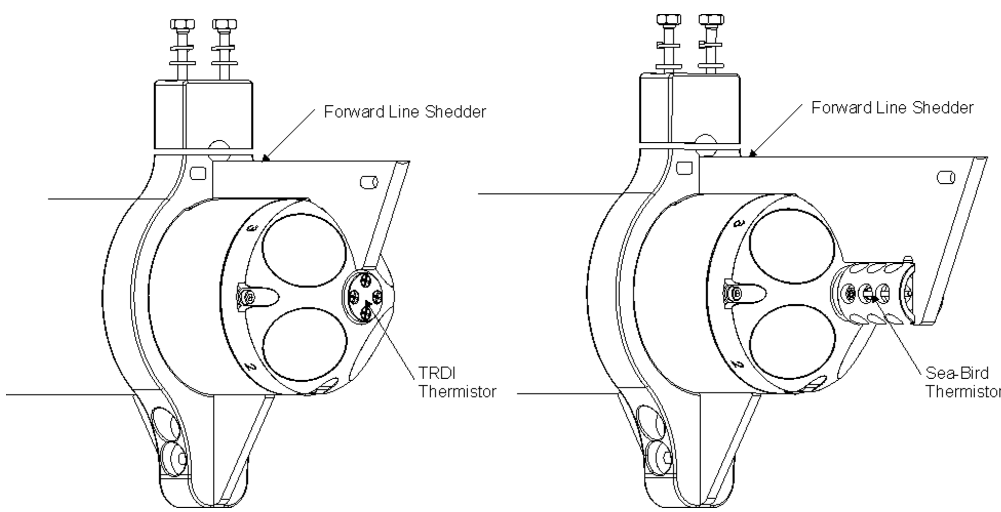


Figure 2. DVS Temperature Sensor Configurations

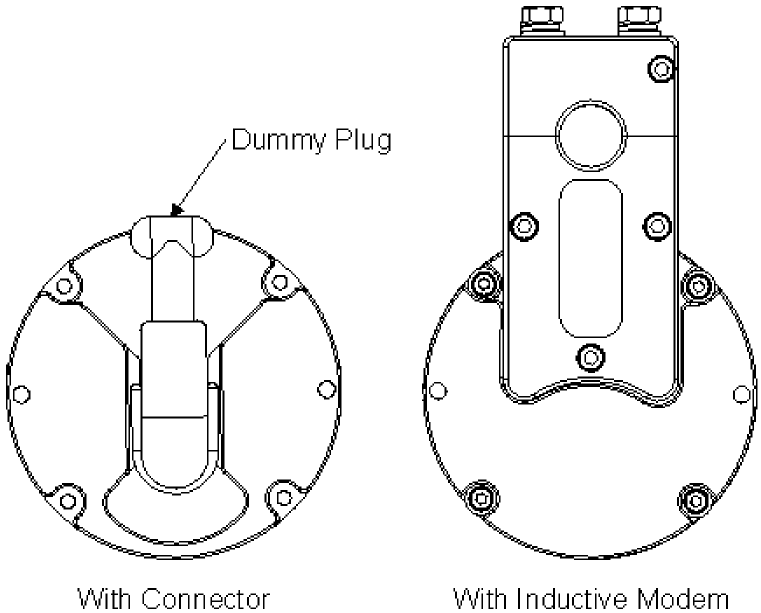


Figure 3. DVS End-Cap Configurations

> **NOTE.** For DVS systems with the end-cap connector, the dummy plug should be installed any time the I/O cable is removed. Use the dummy plug when the DVS is in storage or is being handled.

1.8 Unpacking

When unpacking, use care to prevent physical damage to the transducer faces, thermistor probe and inductive modem. Use a soft pad to protect the transducer.

1.8.1 Inventory

Items included:

- One (1) Doppler Volume Sampler (DVS)
- Two (2) CDs Containing software and documentation
- One (1) Test Cable for RS232 communications and external power (requires removal of end cap for use)

> **NOTE.** The test cable is only included with systems that have the Inductive Modem Module (IMM).

- One (1) Underwater I/O Cable for RS232 communications and external power

> **NOTE.** The underwater cable is only included with systems that have the connector on the end-cap.

- One (1) Shipping Container
- One (1) Tool kit including basic spares
- Calibration sheet for the Sea-Bird Electronics Thermistor if so equipped

Optional Items:

- Two (2) Mounting Clamps with Hardware
- Two (2) Line Shedding Inserts for the Mounting Clamps
- One (1) Forward Line Shedding Insert for the Thermistor Probe
- One (1) optional large vane can be used in place of the two small line shedders

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.

1.8.2 Visual Inspection of the DVS

Inspect the DVS using the following table and figures. If you find any discrepancies, call TRDI for instructions.

Table 2: Visual Inspection Criteria

Item	Inspection Criteria
Transducer Assembly	Check the urethane faces. There should be no gouges, dents, scrapes, or peeling (see Figure 4).
Housing Assembly	For DVS high pressure systems, check the paint. There should be no gouges, dents, scrapes, or peeling.
Temperature Sensor	For DVS systems with the Sea-Bird Thermistor, check the sensor is not bent and the guard is attached (see Figure 4).
Inductive Modem	For DVS systems with the inductive modem, check the urethane face. There should be no gouges, dents, scrapes, or peeling (see Figure 5).
Test Cable or I/O Cable	Check the cable connectors for cracks or bent pins.

Figure 4. Standard DVS Transducer with Sea-Bird Thermistor

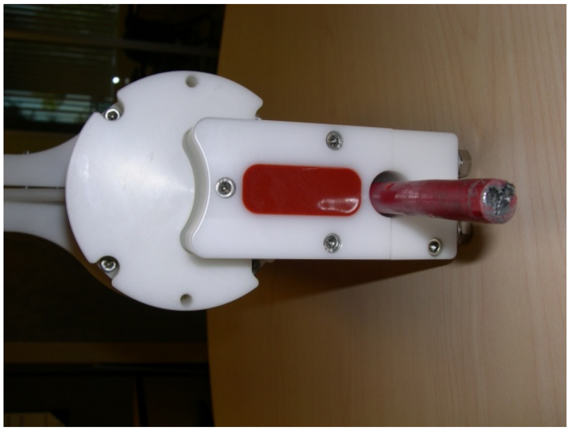


Figure 5. DVS End-Cap View with Inductive Modem

2 Installation

This section is a guide for installing the DVS on a mooring line. Use this section to plan your installation layout.

CAUTION. Always use caution when mounting the DVS. Never rest the transducer head on a rough surface. Use foam padding to protect the transducer during handling (see DVS Care).

2.1 Mooring Line Clamps

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

a. Install the two mounting clamps and line shedders on the DVS housing (see Figure 6).

b. Remove the inductive modem line clamp from the inductive modem.

c. Clamp the mooring line between all three line clamps. Note that it is acceptable for the mooring line to have play within the IMM clamp.

NOTE. The diameter of the mooring line must be 9 to 19 mm (0.35 to 0.75 inch).

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

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

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

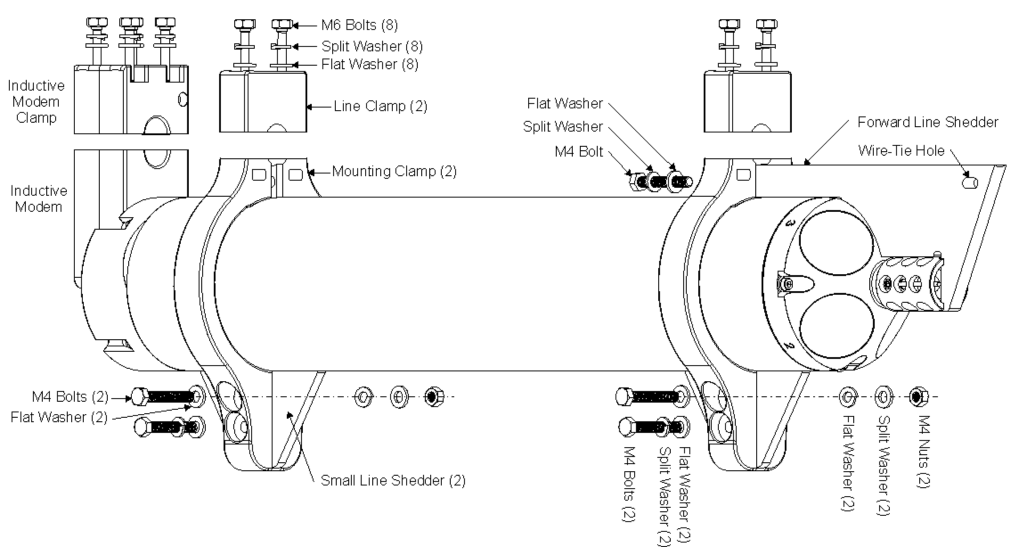


Figure 6. Mounting Hardware

2.2 Installing the Optional Vane

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.

a. Remove the two small line shedders.

b. Install the vane using the hardware from the two small line shedders (see Figure 7).

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

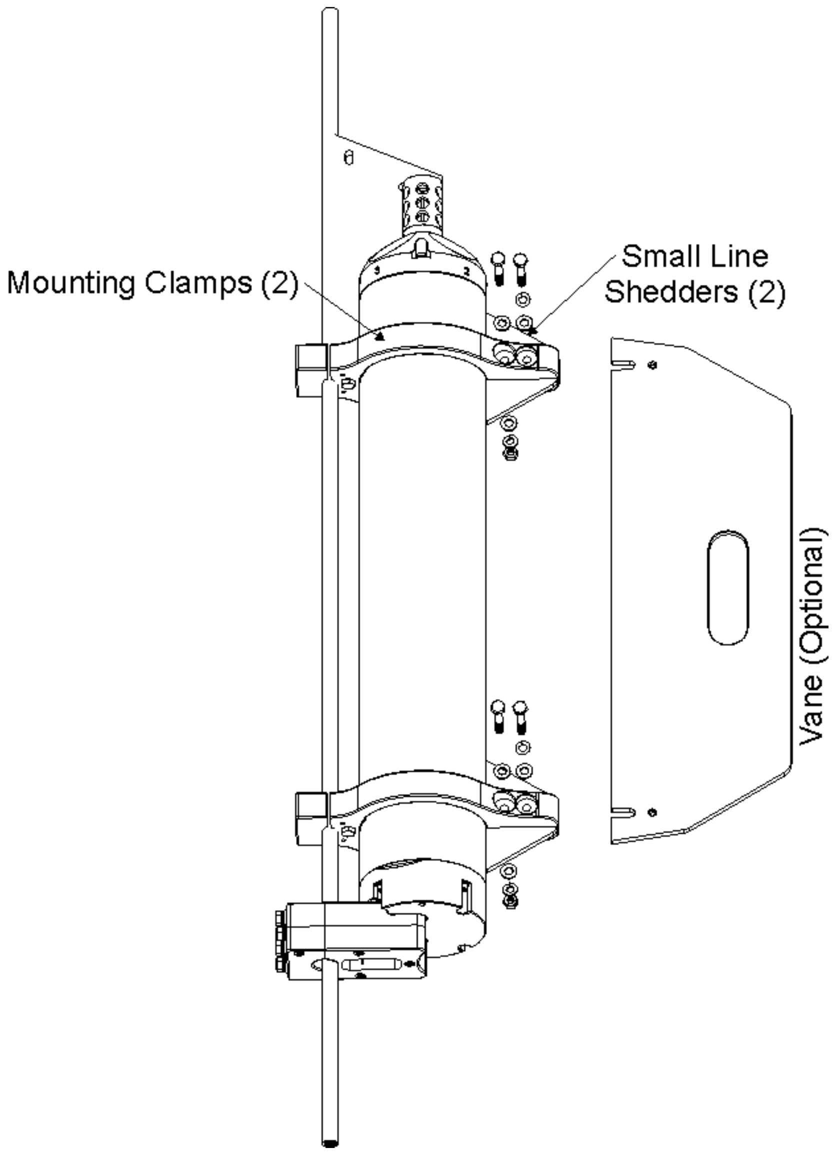


Figure 7. DVS Optional Vane Installation

2.3 Specifications

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

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

The DVS is a low-cost, special-purpose Acoustic Doppler Current Profiler (ADCP) that is designed to operate as a single-point current meter with an optional oceanographic-grade temperature measurements and an integrated, internal inductive modem. The DVS is designed to operate at a system frequency of 2400 kHz for high-precision, short range profiling, and can be deployed in a wide range of environments, including:

- Shallow water (a few meters)
- Buoy mounted
- In-line mooring mounted

The DVS allows several modes of operation for flexibility. In polled operation, the DVS will take one or more samples on command, and transmit the data, including a time stamp, via the inductive modem. In Autonomous operation, the DVS can be set to sample data at pre-programmed intervals, storing the data in internal flash memory for later recovery. In addition, the surface inductive modem can request the last ensemble placed in flash memory at the pre-programmed interval. It can also periodically request averages of ensembles stored since the last request.

The DVS defines a "sample" as a group of pings that are averaged over a period of 1 second. The user can specify the number of samples to collect and average together into an ensemble for output, and can also specify the time between samples within an ensemble, as well as the time between ensembles. By setting the time between samples, the user can choose whether an ensemble will consist of samples taken consecutively in a burst, or spread out over the time of the ensemble interval.

The DVS is capable of running an autonomous deployment in such a way that communication with the instrument need not interrupt data acquisition. The DVS will allow a polled sample to be taken without interrupting an autonomous deployment, provided that configuration allows extra time for a polled sample. If a polled sample is requested at a time that would interfere with a pre-programmed sample, the pre-programmed sample has precedence, and the polled request will be rejected.

Table 3: Physical Specifications

Physical:	
Weight-in-air	See outline installation drawings
Weight in water	See outline installation drawings
Maximum Dimensions L x W	651x102 mm
4 Bean Janus Transducer:	
Frequency	2457.6 kHz
Beam width, two-way	0.65 deg. (typical)
Number of beams	4
Beam angle	45 deg.
Bandwidth	> 25%
Recorder:	
Flash Memory	16 MB
Real Time Clock:	
Accuracy	TBD ppm
Resolution	0.01 sec.

Table 4: Power Specifications

Power:	
Input Voltage Range	10.6 to 28 VDC
Input Power, asleep	<2.5 mW
Input Power, processing	1.1 W
Input Current, average @ 18V, xmt = 0.5m	70 mA
Battery Chemistry, Capacity	Alkaline, 18 VDC
Battery Shelf Life	Use within one year.
Transmit:	
XMIT Duty Cycle	40%
XMIT Power Beam @ 18 V	1 W (typ)

NOTE. Batteries stored for more than 12 months should NEVER be used! Batteries less than 12 months old may be used for any length deployment. For example, if your deployment is going to be 12 months long and the battery label shows it is nine months old, it is safe to use the battery.

Table 5: Environmental Specifications

Environmental:	
Safety:	IEC 61010-1 2ND. ED, 2001-02
Safety: Vent	Allow pressure to vent before end cap screws disengage
Operating Temperature	-5 to 40 deg. C
Storage Temperature	-25 to 60 deg. C
Strumming	see TAO Vibration Test spread sheet
Vibration	EN 60945
Shock	EN/IEC-1010(8.4.1)
Corrosion	Immune to sea water

Table 6: Interface Specifications

User Interface:	
Serial Communication Options	RS-232, IMM Soft Break control
Serial Baud Rates	1200 to 115200 bps 9600 bps maximum for the inductive modem
Serial Data Formats	Binary PD0/PD20
System Control	Set of commands sent via serial interface and supporting software
Underwater Inductive MODEM:	
Serial Communication Options	1200 baud
Software:	
OS	Windows 2000, XP
Included Programs	*DVS* and *WinADCP*

Table 7: Velocity Specifications

Velocity Measurement, BB	
Velocity Range	+/- 0.6 m/s
Velocity Resolution	1 mm/s
Accuracy @Transmit, cell = 0.25 m	+/- 1.0% +/- 0.5 cm/s
1 second Precision, cell = 0.25m	7 mm/s
Number of cells	1 to 5
Cell Size	0.25 – 1.0 m
First cell Blank	0.2 m
Profiling Range: 35 ppt, 10 deg. C, 18V, bin = 0.25m	3 m (typ)
Integration time	1 s
Ping rate	Bin size dependent up to 40 Hz

Table 8: Echo Intensity Specifications

Echo Intensity:	
Echo Intensity, min	30 cnt (typ)
Echo Intensity, max	205 cnt (typ)
Echo intensity scale factor	0.50 +/- 0.06 db/cnt
Relative Echo accuracy	< 2.5 dB rms
Echo Intensity Dynamic Range	80 dB (typ)

Table 9: Sensor Specifications

Temperature (TRDI):	
Range	-4 to 45 deg. C
Accuracy	+/- 0.5 deg. C (typical)
Precision	0.0625 deg. C
Resolution	0.01 deg. C

High Resolution Temperature (SB38):	
Range	+1 to 35 deg. C
Accuracy (Not biased by solar radiation)	+/- 0.005 deg. C (typical)
Precision	0.005 deg. C
Resolution	0.001 deg. C
Drift over 2 years	0.02 deg. C
Compass/Tilts: TCM5	
Heading Range	0° to 360° +/-30,+/-30 deg.
Heading Resolution	0.01°
Heading accuracy (tilt < 70°)	2°
Pitch range	-70° to +70°
Roll range	-70° to +70°
Pitch/Roll resolution	0.01°
Pitch accuracy	1°
Roll accuracy (for Pitch < 65°)	1°

2.4 Outline Installation Drawings

The following drawings show the standard DVS and dimensions and weights.

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

NOTE. The outline installation drawings show the optional mounting hardware and line shedders.

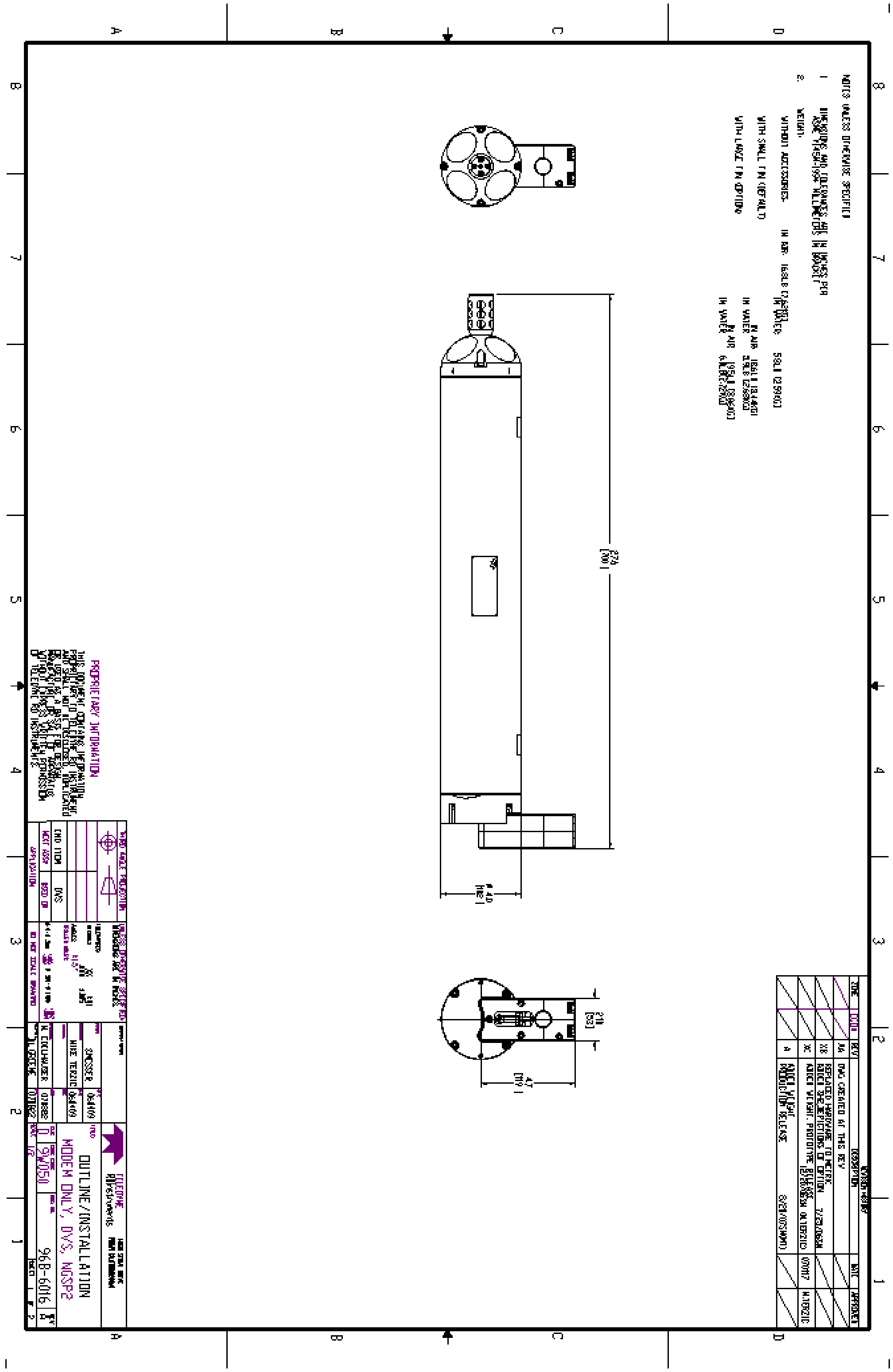


Figure 8. Outline Installation Drawing 96B-6016 Sheet 1

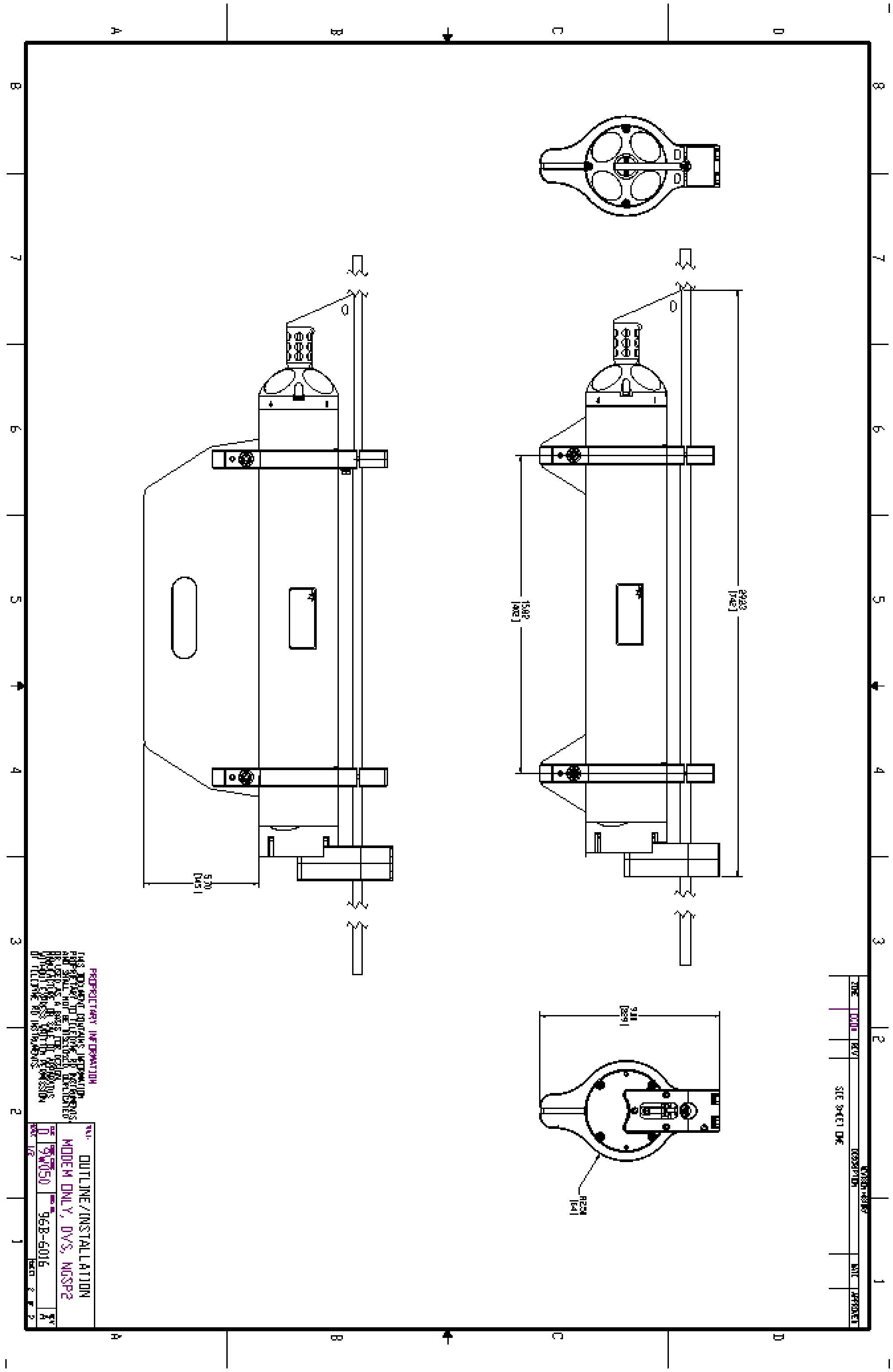


Figure 9. Outline Installation Drawing 96B-6016 Sheet 2

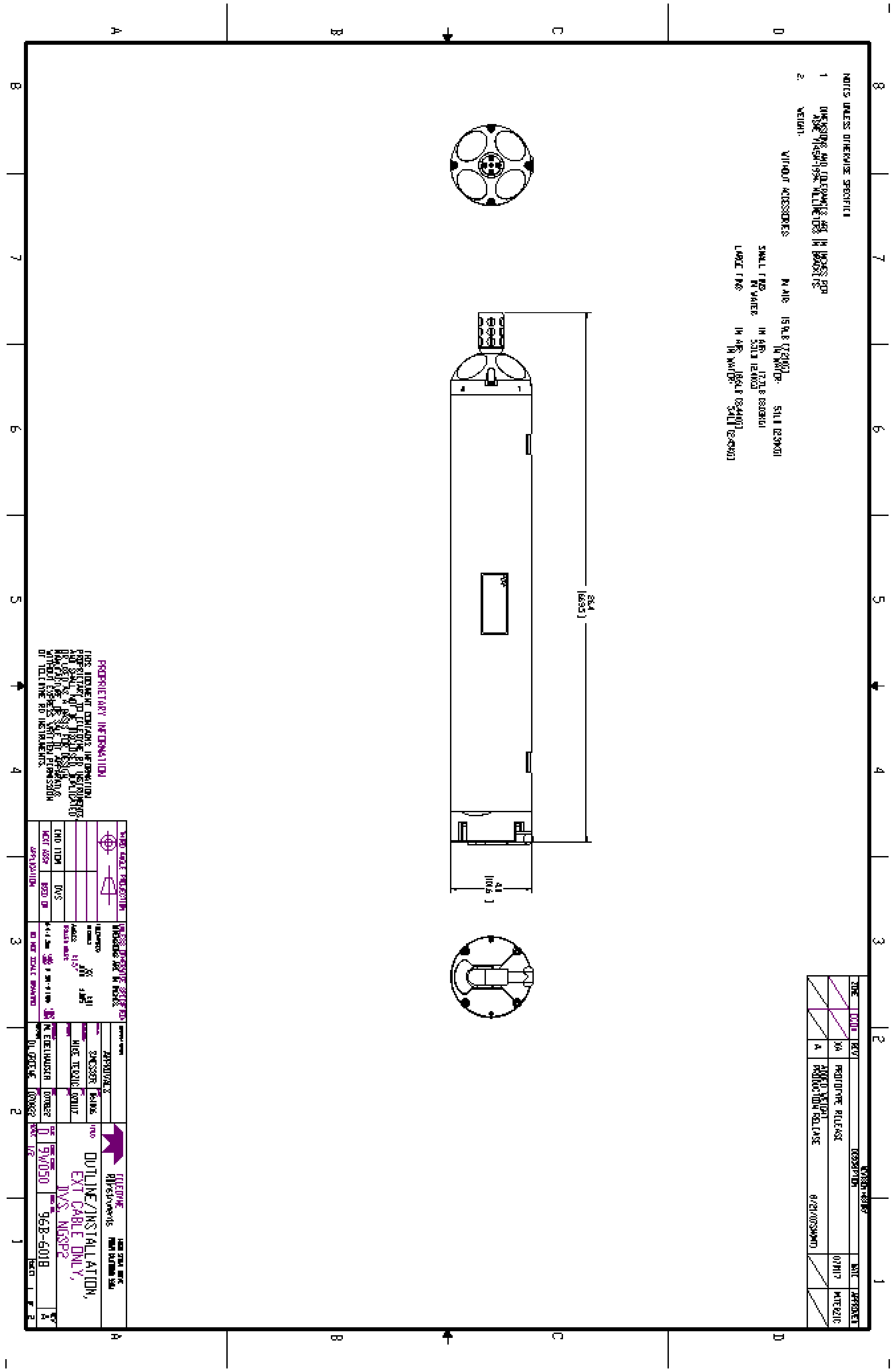


Figure 10. Outline Installation Drawing 96B-6018 Sheet 1

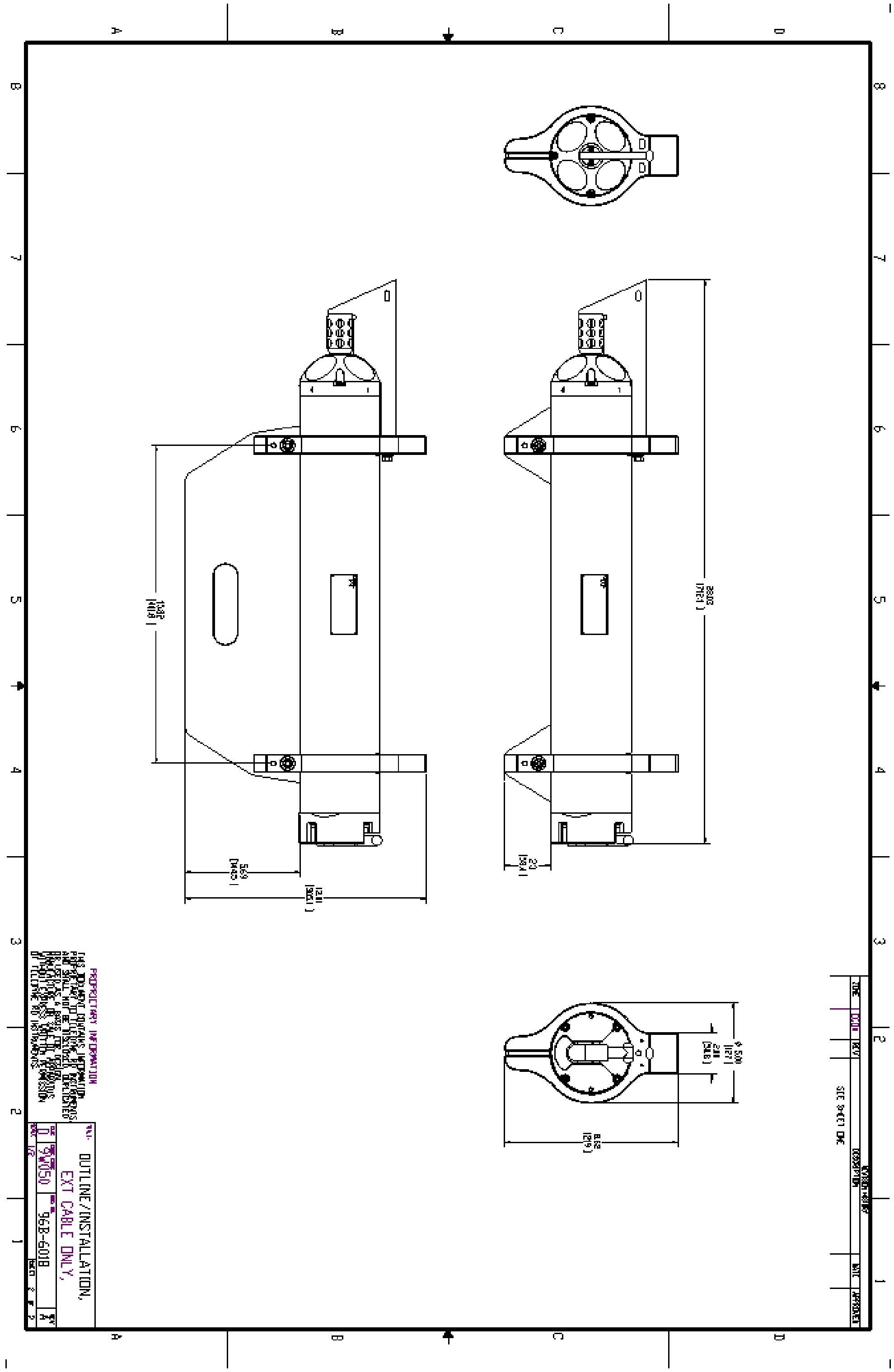


Figure 11. Outline Installation Drawing 96B-6018 Sheet 2

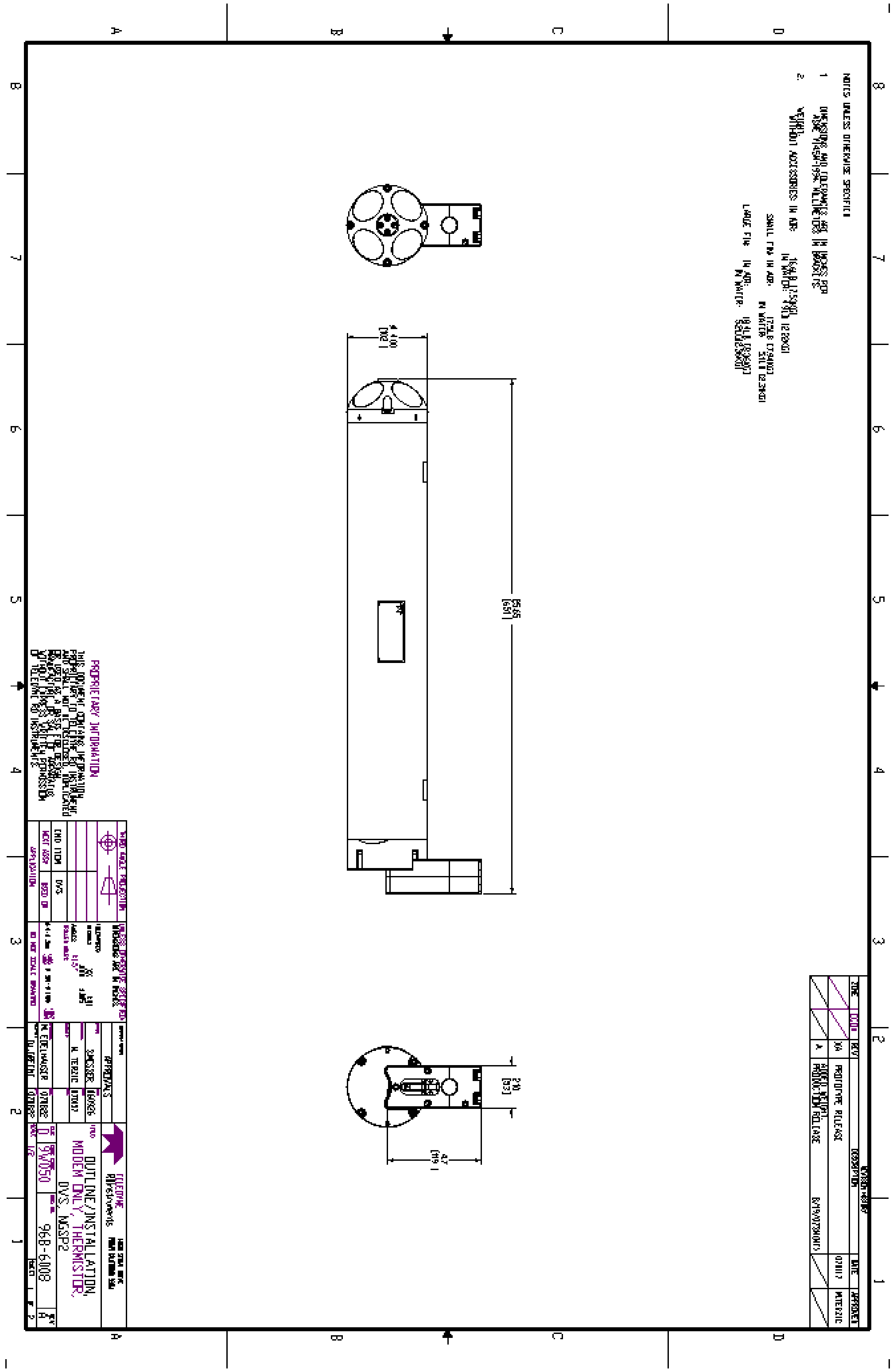


Figure 12. Outline Installation Drawing 96B-6008 Sheet 1

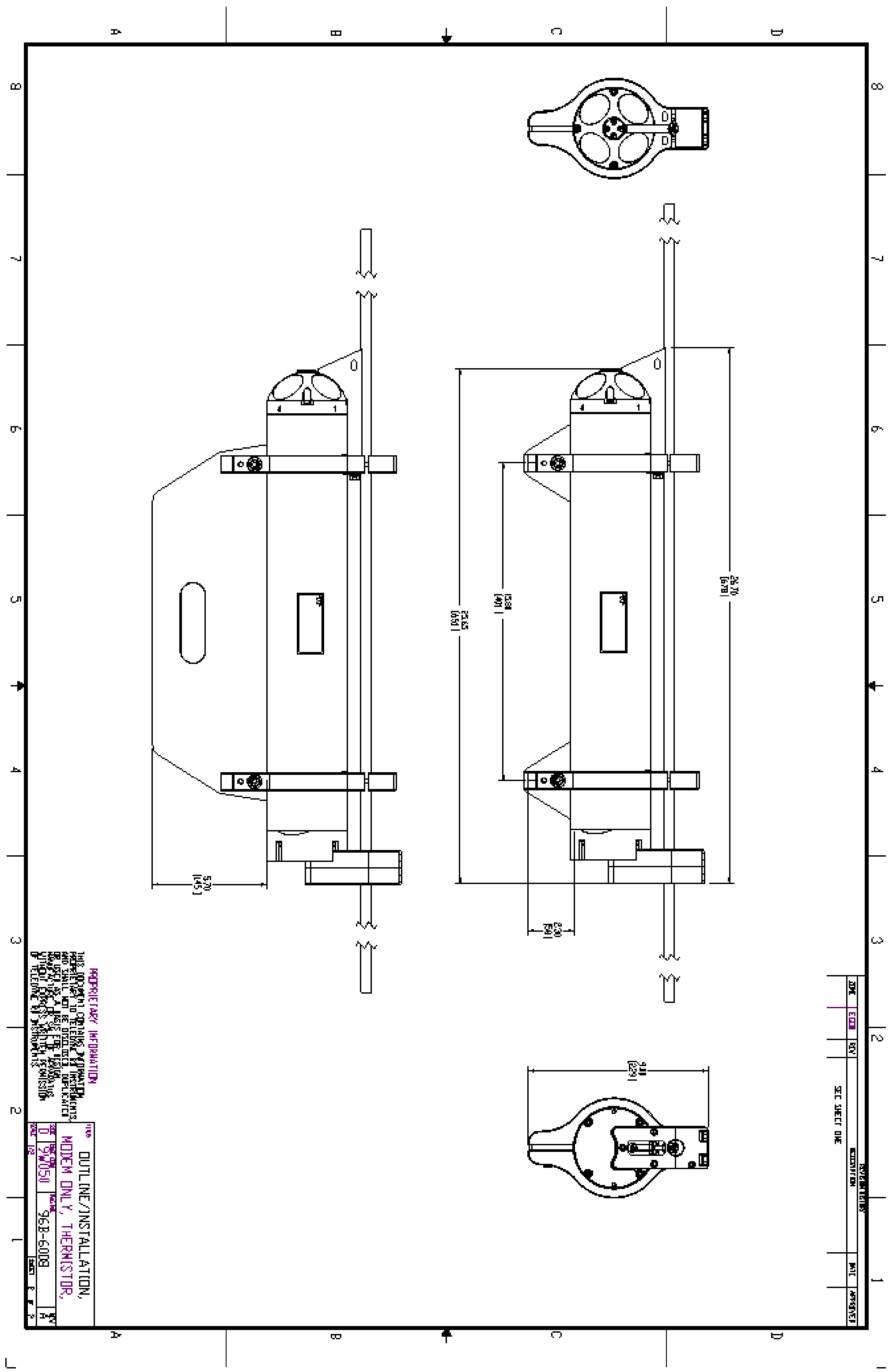


Figure 13. Outline Installation Drawing 96B-6008 Sheet 2

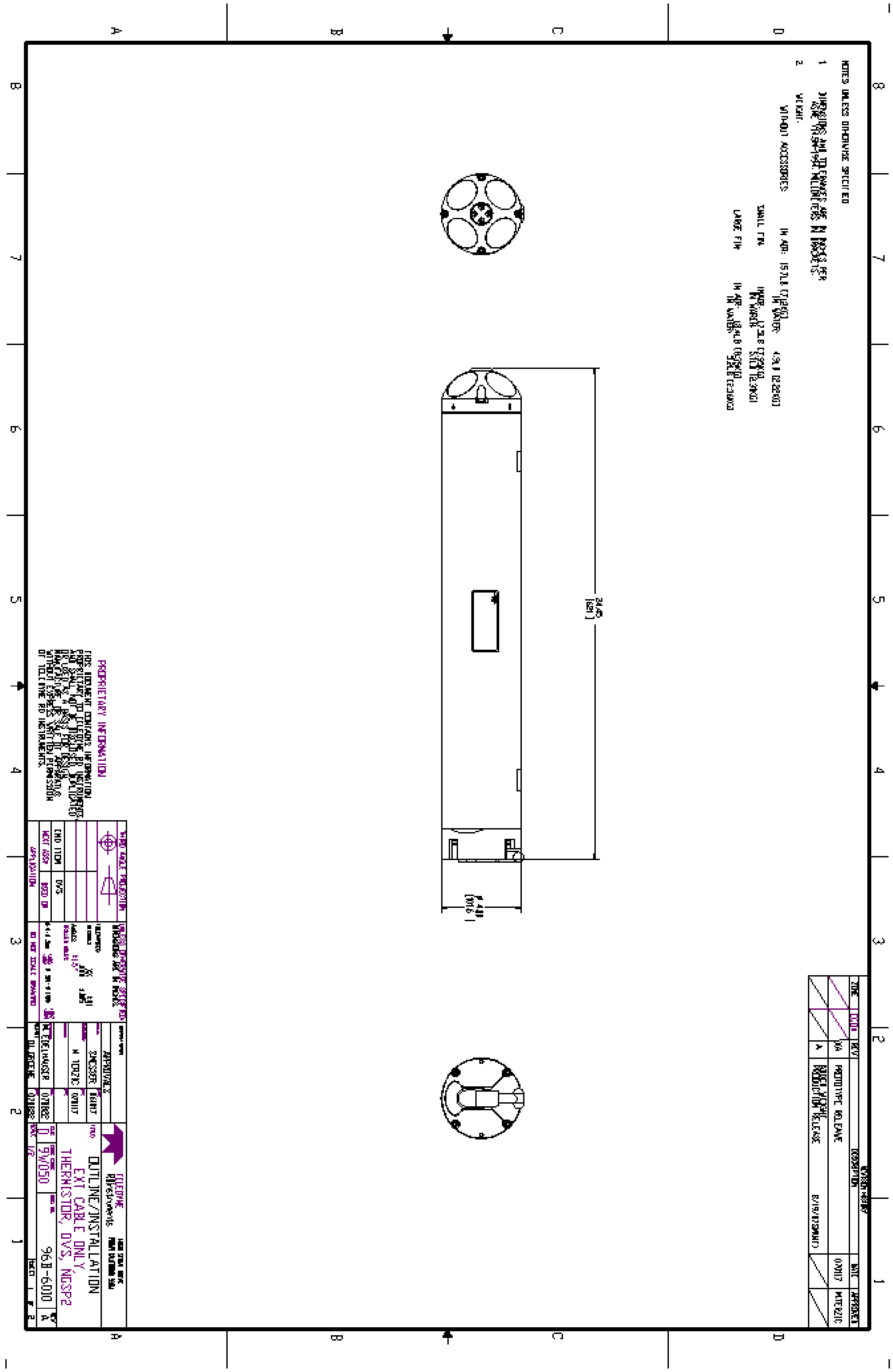


Figure 14. Outline Installation Drawing 96B-6010 Sheet 1

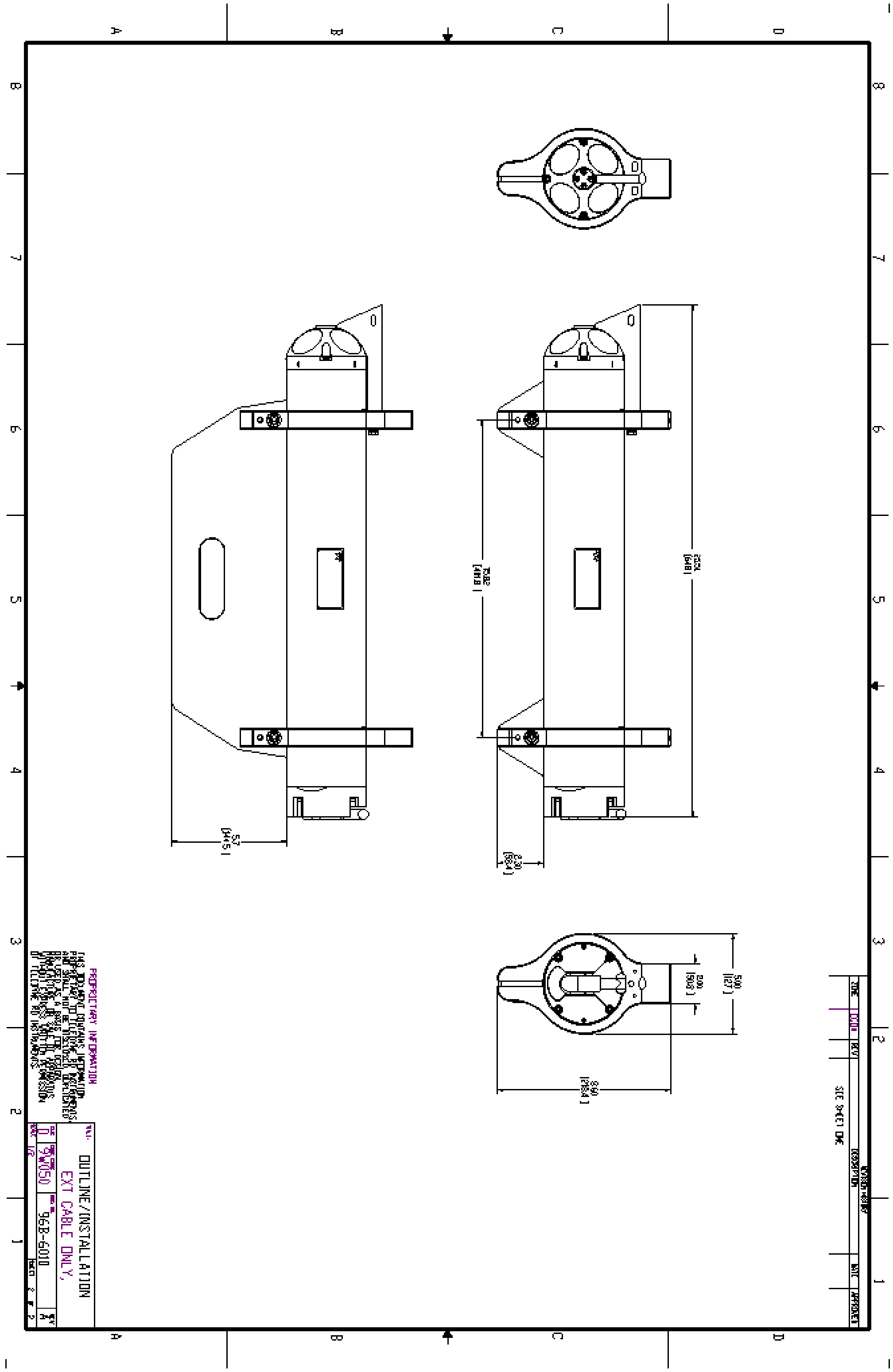


Figure 15. Outline Installation Drawing 96B-6010 Sheet 2

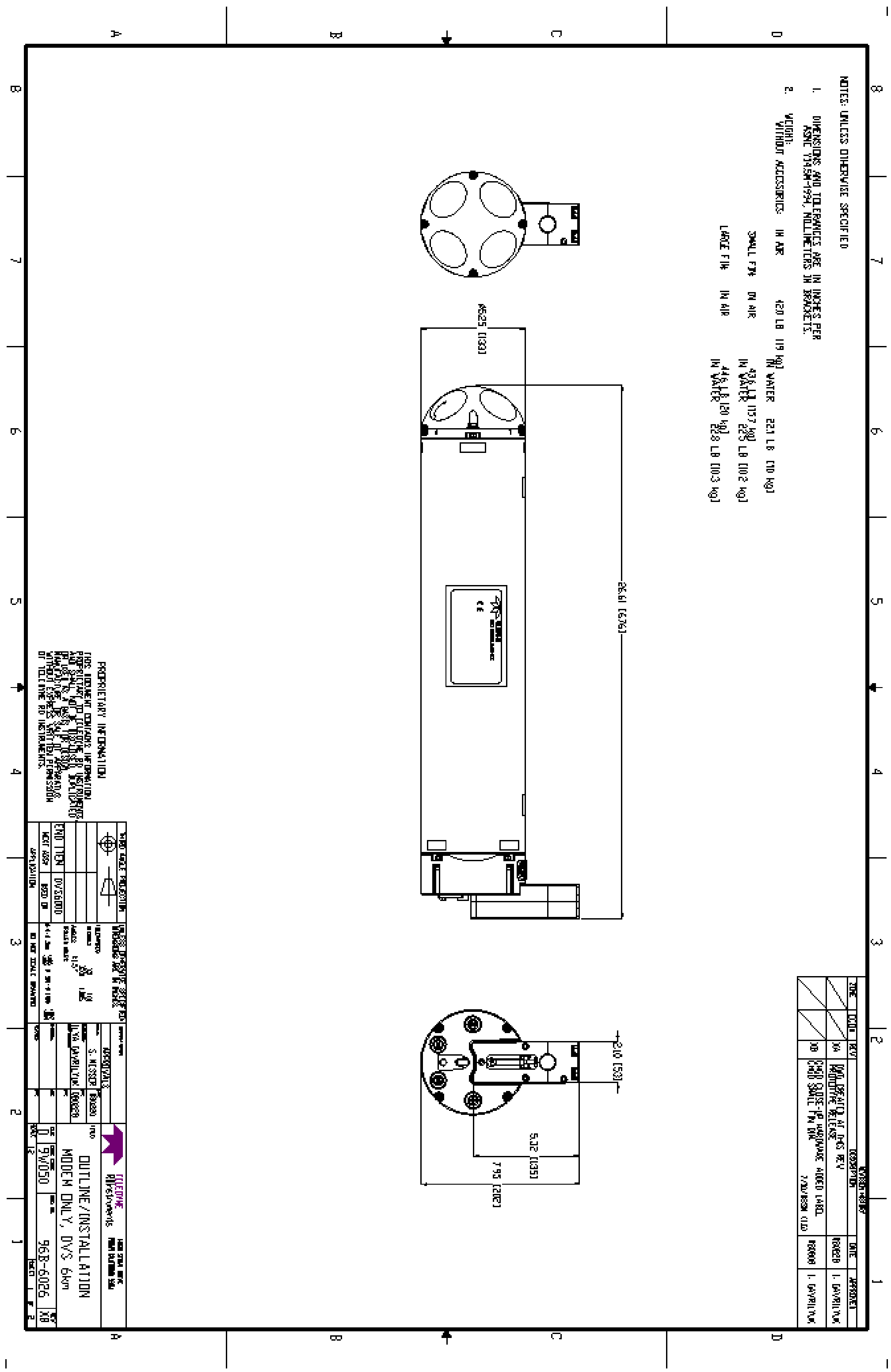


Figure 16. Outline Installation Drawing 96B-6026 Sheet 1

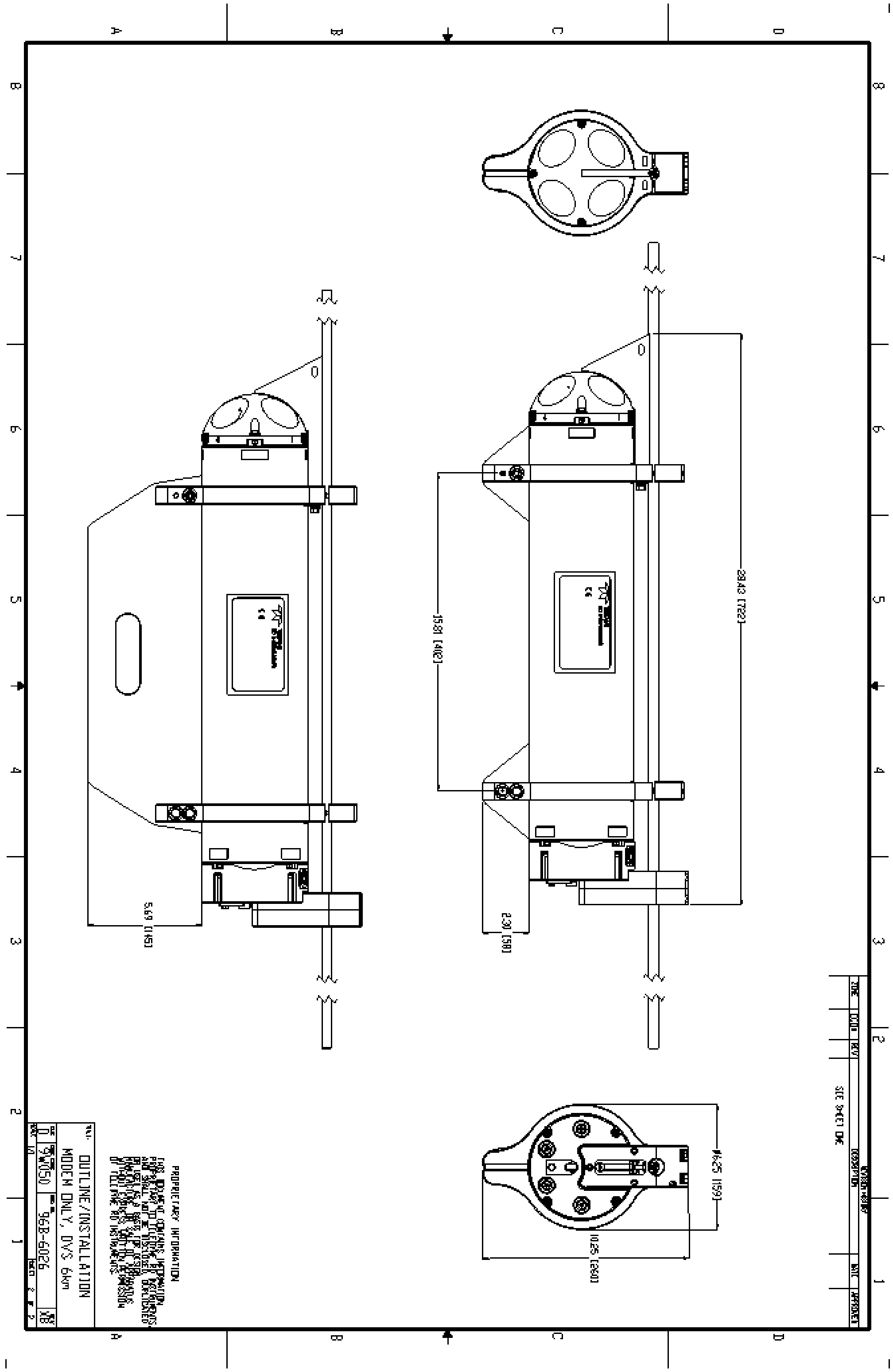


Figure 17. Outline Installation Drawing 96B-6026 Sheet 2

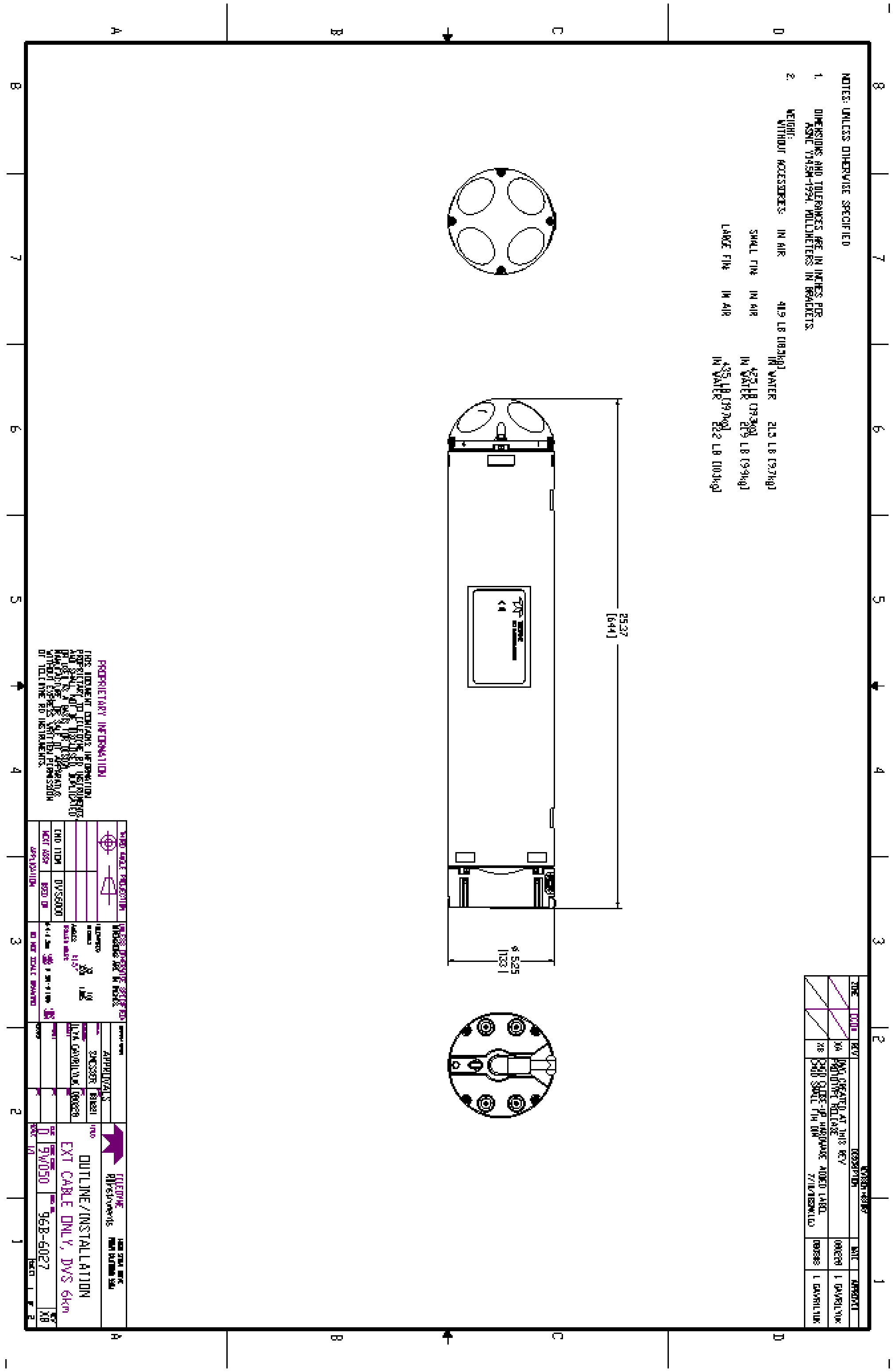


Figure 18. Outline Installation Drawing 96B-6027 Sheet 1

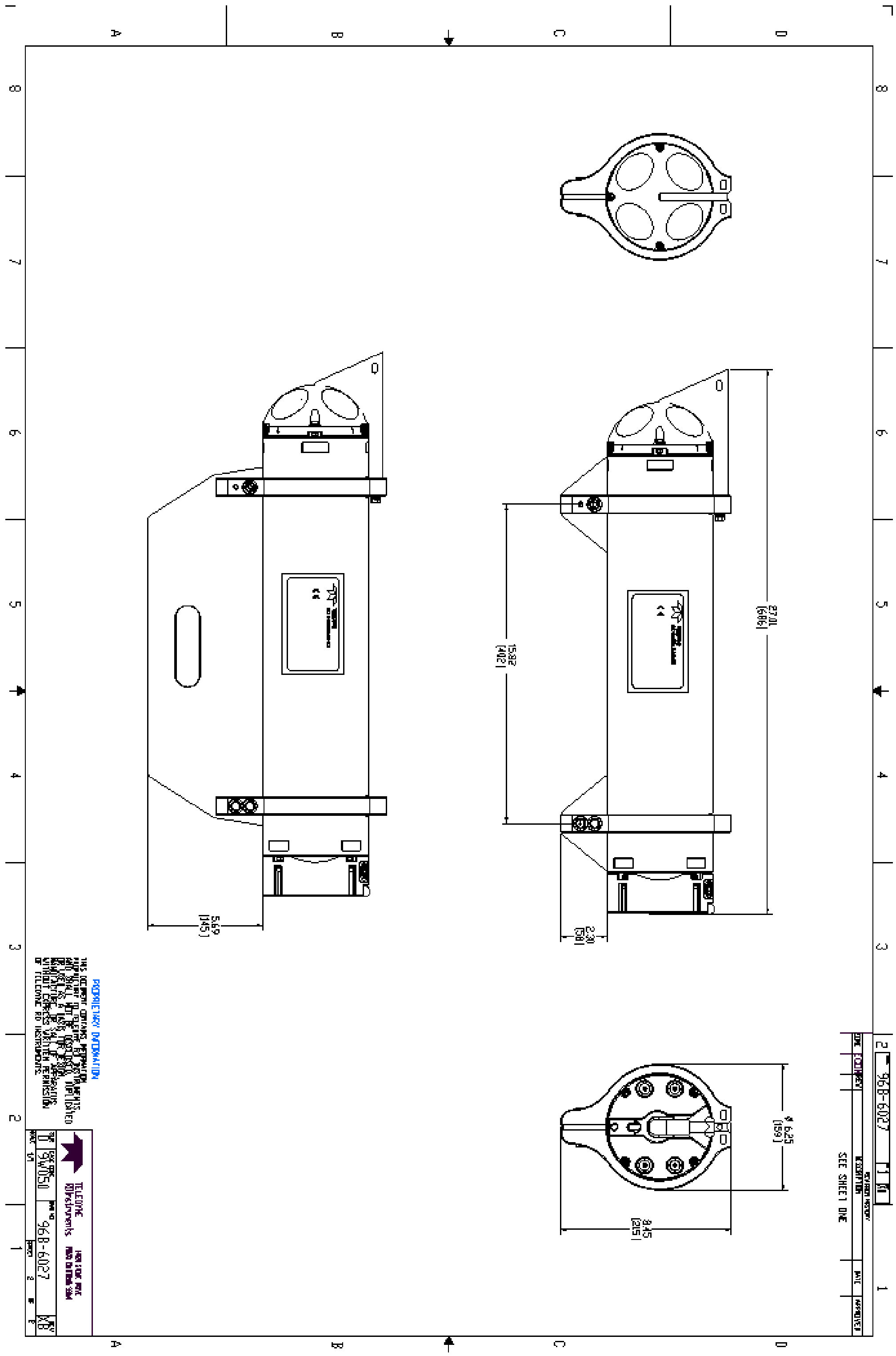


Figure 19. Outline Installation Drawing 96B-6027 Sheet 2

3 Maintenance

This section explains how to prepare the DVS for deployment, how to do certain maintenance procedures, and how to prepare the DVS for storage or shipment.

3.1 Spare Parts

Table 10 lists the items in the spares parts kit. Use this kit when doing routine DVS maintenance.

Table 10: DVS Spare Parts

Item #	Description	Part #
1.	Desiccant	01AP18J12
2.	Silicone lubricant, 4-pack	5020
3.	Wrench, 3MM, ball end, L	5503A39
4.	Washer, Small OD, 8MM SST	M4WASHSMOD
5.	Washer, Split Lock, SST	M4WASHSPL
6.	Screw, SHCS SST	M4X0.7X30SH
7.	Screw, SHCS SST	M4X0.7X50SH
8.	Nut, Hex, SST	M4X0.7NUT
9.	O-ring, EPDM, DURO 70, standard 750 meter housing	2-233
10.	O-ring, face, 2-242, 6000 meter housing	2-242
11.	O-ring, bore 2-234, 6000 meter housing	2-234 N140-90
12.	O-ring, bore backup 8-234, 6000 meter housing	8-234 N300-90
13.	Isolator, 1/4 Long, Screw #8, Nylon	91145A148
14.	Isolator, 1/2 Long, Screw #8, Nylon	91145A151
15.	Isolator, 3/4 Long, Screw #8, Nylon	91145A154
16.	Anode, end-cap	810-4006-00
17.	Anode, transducer	810-4005-00
18.	Screw, Flat Head, SST	M5X0.8X10FH
19.	Insert, Housing	81B-4072-00
20.	Sealant, Silicone 85MM, 2.7 oz/Tube	59530
21.	Threadlocker,Permanent,10ml Loctite	271

NOTE. Items 1 – 8 are included with all systems. Item 9 is used on the standard DVS only. Items 10-21 are used on the 6000 meter DVS system.

3.2 I/O Cable and Dummy Plug

For DVS systems with the end-cap connector, the underwater connector (on the end-cap) and the I/O cable and dummy plug are molded connectors. The end-cap connector is a factory-installed item. We do not recommend removing it for any routine maintenance.

> **CAUTION.** When disconnecting or connecting the DVS I/O cable, do not apply any upward force on the connector as it is being pulled off. Applying an upward angle as the cable is disconnected puts stress on the end-cap connector. This may cause several serious problems:
>
> a) The end-cap connector or connector pins can crack.
> b) The O-ring on the bottom of the end-cap connector can be damaged.
> c) The molded urethane on the end-cap connector may separate from the brass insert.
>
> **If the end-cap connector is damaged in any of these ways, your DVS will flood.**

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

Disconnecting the I/O Cable or Dummy Plug

The cable or Dummy Plug should be disconnected with a straight outward motion only.

a. Release the retaining strap by pulling it over the connector.

b. Grasp the cable close to the end-cap. Your thumb should rest against the edge of the end-cap.

c. Pull the cable straight out away from the end-cap. Do not apply any upward force on the connector as it is being disconnected.

Connecting the I/O Cable or Dummy Plug

To connect the cable, the cable should be connected with a straight inward motion only.

a. Apply a light coat of silicone lubricant to the rubber portion of the end-cap connector pins. This will help seat the connector.

b. Gently push the cable straight in toward the end-cap connector. Do not apply any upward force on the connector as it is being connected.

c. Roll the retaining strap over the connector.

3.3 DVS Disassembly

This section explains how to remove and replace the end-cap or transducer head to gain access to the DVS's battery and electronics. Read all instructions before doing the required actions.

3.3.1 Tension Cord

When disassembling the DVS, keep in mind that there are cables connected to both the end-cap and transducer assemblies. The tension cord shown in Figure 20 prevents the transducer/end-cap assemblies from being pulled too far away from the housing which could cause damage to the internal cables. Once the cables are disconnected, loosen the thumbscrew holding the tension cord in place.

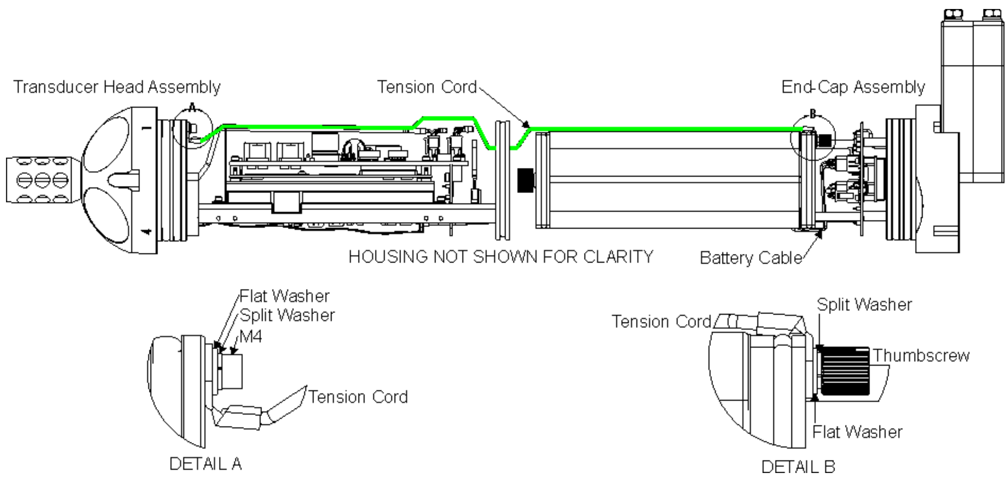


Figure 20. Tension Cord Overview

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

3.3.2 End-Cap Removal Procedures

NOTE. This procedure applies to the standard 750 meter housing only. For instructions on how to remove the 6000 meter housing end-cap, see High Pressure Housings.

To remove the end-cap, do the following steps. Use Parts Location Drawings for parts identification.

a. Dry the outside of the DVS.

b. Lay the DVS on its side on a soft pad.

c. Remove all power to the DVS.

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

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

e. Begin threading both the End Cap Removal M6 setscrews in as shown in Figure 21 to back the end cap out of the housing (750 m DVS only).

NOTE. The 750 meter DVS housing end-cap side of the housing has two metal inserts to protect the housing from the End Cap Removal setscrews.

The End Cap Removal M6 setscrews use the same size hex key as the M4 bolts.

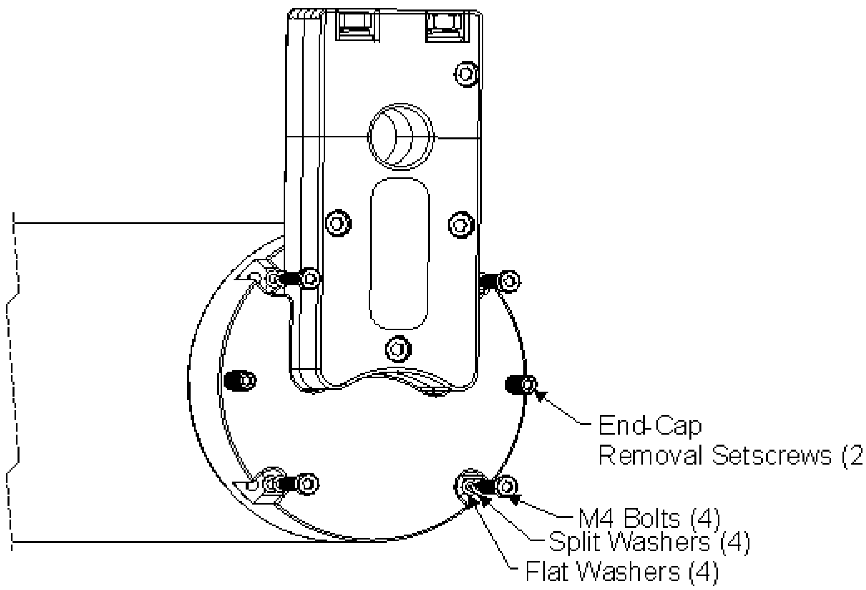


Figure 21. End Cap Mounting Hardware (Standard 750 Meter System)

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

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

h. 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 (see Figure 22).

i. Disconnect the tension cord (green wire).

j. Gently pull the end-cap and battery assembly away from the housing.

Figure 22. Removing the End-cap

3.3.3 Transducer Head Assembly Removal

NOTE. This procedure applies to the standard 750 meter housing only. For instructions on how to remove the 6000 meter housing transducer head, see High Pressure Housings.

CAUTION. Normal maintenance does not require removing the transducer head. **Only use the following procedures if directed to do so by TRDI Field Service personnel.**

NOTE. When you need access to the DVS internal battery, remove the end-cap assembly (see End-Cap Removal Procedures).

a. Remove all power to the DVS.
b. Lay the DVS on its side on a soft pad.
c. Remove the end-cap (see End-Cap Removal Procedures).
d. Remove the four M4 retaining bolts.
e. Carefully slide out the transducer head assembly.
f. When you are ready to re-assemble the DVS, see DVS Re-assembly.

3.4 DVS Re-assembly

To replace the end-cap and transducer head, proceed as follows. Use Parts Location Drawings for parts identification.

a. If you are sealing the DVS for a deployment, be sure you have done all appropriate maintenance items (see Sealing the DVS for a Deployment).

b. Make sure all printed circuit boards, spacers, cables, and screws have been installed.

c. Install two fresh bags of desiccant just before closing the DVS (see Desiccant Bags).

3.4.1 O-Ring Inspection and Replacement

This section explains how to inspect/replace the DVS O-rings. A successful deployment depends on the condition of these O-rings and their retaining grooves. See Parts Location Drawings for the locations of the following O-rings. Read all instructions before doing the required actions.

Standard 750 meter DVS System

- End-cap assembly, two 2-233 O-rings
- Transducer assembly, two 2-233 O-rings
- Battery assembly, 2-150 (for vibration prevention, not water-tight)
- Electronics assembly, 2-233 (for vibration prevention, not water-tight)

3000 meter DVS System

- End-cap/transducer assembly, face, 2-242 O-ring
- End-cap/Transducer assembly, bore 2-234 O-ring
- End-cap/Transducer assembly, bore backup 8-234 O-ring
- Battery assembly, 2-150 (for vibration prevention, not water-tight)
- Electronics assembly, 2-233 (for vibration prevention, not water-tight)

NOTE. 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.

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

NOTE. The O-rings should be replaced on a yearly basis or whenever the system is prepared for a deployment.

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

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

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

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

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

d. Lubricate the O-ring with a thin coat of silicone lubricant (Table 10). Apply the lubricant using latex gloves. Do not let loose fibers or lint stick to the O-ring. Fibers can provide a leakage path.

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

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

3.4.2 End-Cap Replacement

NOTE. If the transducer head assembly was removed, replace it first before installing the end-cap.

This applies to the standard 750 meter housing. For instructions on how to replace the 6000 meter housing end-cap, see High Pressure Housings.

a. Lay the DVS on its side on a soft pad.

b. Inspect, clean, and lubricate the O-ring on the end-cap/battery assembly (see O-Ring Inspection and Replacement). Apply a very thin coat of silicone lube on the O-ring.

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

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

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

c. Connect the tension cord (green wire).

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.**

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

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

NOTE. If you are not deploying the DVS within the next hour, use the DVS software to send the CZ command to put the DVS to sleep.

f. Thread back the End-Cap Removal setscrews so they do not obstruct installing the end-cap (standard 750 m housing only).

g. Slide the end-cap into the end-cap side of the housing making sure that the acoustic modem is aligned with the cable clamps. For the 6000 meter housing, make sure the two banana plugs seat properly into the housing (these plugs ensure the housing is electrically connected to the end-cap for anode protection).

NOTE. The standard 750 meter end-cap side of the housing has two metal inserts to protect the housing from the back out screws.

h. Make sure none of the cables become pinched or that the O-rings fall out of the groove.

CAUTION. Check that no wires or any other object is pinched between the end-cap and the housing. **If the O-rings are not in the groove or if a wire or other object is pinched, the DVS will flood.**

i. Examine the end-cap assembly nuts, bolts, and washers for corrosion; replace if necessary. Figure 21 shows the assembly order of the end-cap mounting hardware. All the hardware items are needed to seal the DVS properly.

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

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

k. 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.

l. Tighten the bolts to the recommended torque value of 10.85 ± 1.0 Newton-meters (96 ± 9 pound-inches).

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

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

NOTE. The recommended torque value for the end-cap 6-mm bolts is 10.85 ± 1.0 Newton-meters (96 ± 9 pound-inches).

3.4.3 Transducer Head Assembly Replacement

NOTE. This applies to the standard 750 meter housing. For instructions on how to replace the 6000 meter housing transducer head, see High Pressure Housings.

a. Lay the DVS on its side on a soft pad.

b. Inspect, clean, and lubricate the O-ring on the housing (see O-Ring Inspection and Replacement). Apply a very thin coat of silicone lube on the O-ring.

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

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

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

c. Replace the desiccant bags just before sealing the housing (see Desiccant Bags).

d. Gently lower the transducer head/electronics assembly into the housing, aligning the mating holes and the circuit boards are facing the same direction as shown in Figure 20. When mating the housing with the transducer head flange try to apply equal pressure to all parts of the O-ring. Make sure the O-rings remain in the retaining groove.

CAUTION. Check that no wires or any other object is pinched between the transducer head assembly and the housing. **If the O-ring is not in the groove or if a wire or other object is pinched, the DVS will flood.**

e. Examine the transducer assembly nuts, bolts, and washers for corrosion; replace if necessary. The Parts Location Drawings shows the assembly order of the transducer mounting hardware. All hardware items are needed to seal the DVS properly.

f. Install all four sets of hardware until “finger tight.”

g. Tighten the bolts in small increments in a “cross” pattern until the split washer flattens out, and then tighten each bolt ¼ turn more to compress the face seal O-ring evenly. Tighten the bolts to the recommended torque value of 10.85 ± 1.0 Newton-meters (96 ± 9 pound-inches). Do not deform the plastic.

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

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

NOTE. The recommended torque value for the transducer head 6-mm bolts is 10.85 ± 1.0 Newton-meters (96 ± 9 pound-inches).

3.5 Desiccant Bags

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

As a minimum, replace the desiccant bags (Table 10) whenever you are preparing to deploy or store the DVS for an extended time.

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

> **NOTE.** Desiccant bags are shipped in a zip lock bag to ensure maximum effectiveness. TRDI recommends replacing the desiccant bag just before the deployment.
>
> The desiccant should be replaced on a yearly basis or whenever the system is recovered from a deployment.

a. Remove the end-cap (see End-Cap Removal Procedures).

b. Remove the transducer head (see Transducer Head Assembly Removal).

c. Remove the old desiccant bags and install two new ones. Place one desiccant bag on top of the end-cap interface board. Place a second desiccant bag on top of the electronics near the transducer head.

d. Install the transducer head assembly and end-cap (see DVS Re-assembly).

3.6 DVS Battery Packs

The DVS system uses battery packs to provide power. Batteries should be replaced when the voltage falls below 13 VDC (measured across the battery connector under no-load conditions).

> **NOTE.** Battery replacement induces both single and double cycle compass errors. The compass must be aligned after the battery is replaced.

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

3.6.1 Battery Replacement

To replace the battery pack, do the following steps.

a. Remove the end-cap (see End-Cap Removal Procedures).

b. Disconnect the red/black battery power cable from the end-cap interface board.

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

d. Remove the end plate.

e. Slide out the used battery pack.

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

g. Test the battery pack voltage by measuring across the battery connector under no-load conditions. The voltage should be +18 VDC for a new battery pack.

h. Position the end plate over the post.

i. Tighten each thumbscrew firmly to hold the battery in place.

j. Connect the red/black battery power cable to the end-cap interface board.

> **NOTE.** If you are not deploying the DVS within the next hour, use the DVS software to send the CZ command to put the DVS to sleep.

k. Replace the desiccant bag just before sealing the housing (see Desiccant Bags).

l. Install the end-cap (see End-Cap Replacement).

m. Align the compass (see Compass Calibration).

3.7 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 end-cap/battery assembly was removed and replaced back in the same orientation, the compass does not require calibration. If the battery core was replaced, you **must** perform a compass calibration.

> **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. 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.

> **NOTE.** **D**o not begin the compass calibration procedure while deployed. Doing so will cancel the deployment.

3.7.1 Compass Calibration with Fixture

TRDI has obtained the best results using a fixture that can rotate the DVS through all three axis. Follow the steps below.

NOTE. For more information on building your own compass alignment fixture, contact TRDI (see Technical Support).

Figure 23. Compass Calibration Fixture

a. Connect and power up the DVS unit as shown in Figure 37 or Figure 38. 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.

b. Mount the DVS in the jig. 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.

c. Start the *DVS* software.

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

e. Send the SC1 command to reset the compass to the default calibration (see Using the DVS Software Terminal Screen).

f. Using the PC2 command, line the compass up to 0° heading with the default calibration.

g. Click **OK** to exit the Terminal Screen.

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

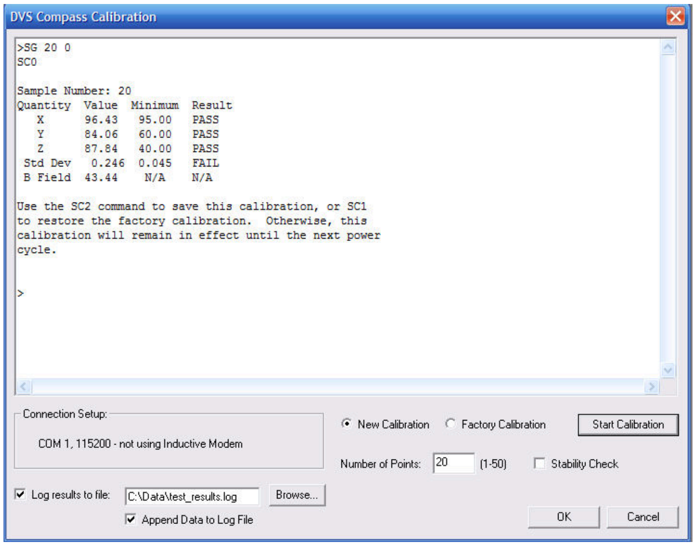


Figure 24. DVS Compass Calibration

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

j. **Number of Points** is the number of samples that the compass will take during a field calibration: the minimum recommended samples are 20.

k. Select the **Stability Check** box. When the **Stability Check** is selected, the DVS waits for it to stop moving before it takes a sample. Otherwise, it will take a sample whenever the minimum position change criteria have been met.

l. Click the **Start Calibration** button to begin the calibration. All rotations should be done in 90° increments with a short pause to allow the DVS to take a sample. Move the DVS in fluid motions to avoid samples from being taken in the wrong locations.

    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

m. Continue through the steps until the DVS compass calibration finishes. For 16 samples, most calibrations end on step 9.

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

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

3.7.2 Compass Calibration without Fixture

If you do not have access to a compass alignment jig, you will need to perform a hand calibration instead. The procedure is the same regardless of whether or not your DVS end cap is an inductive modem design or a 6 pin serial connector design. If you have an inductive modem end-cap, make sure your surface modem is configured to constantly be awake so it can communicate with the DVS.

Figure 25. Compass Calibration by Hand

a. Connect and power up the DVS unit as shown in Figure 37 or Figure 38. 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.

b. Start the *DVS* software.

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

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

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

f. **Number of Points** is the number of samples that the compass will take during a field calibration: the minimum recommended samples are 20.

g. Leave the **Stability Check** box un-checked. Selected means it waits for the DVS to stop moving before it takes a sample. Unselected means the Stability feature is not in effect and that the compass will take a sample whenever the minimum position change criteria have been met.

h. Place the DVS on a SOFT pad such as a computer mouse pad. 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.

CAUTION. 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.

NOTE. Make sure the protective guard is properly secured over the high resolution temperature sensor.

Hand calibration of the DVS is performed without a jig but in a similar fashion as the jig calibration. Follow the same pitch, rolls, and rotations as described for the jig calibration except perform the movements between each position slowly.

NOTES.

This procedure assumes that beam 3 is pointing forward (away from the user).

Do **not** turn the DVS in the opposite direction of the deployment position during the calibration (for example, do not calibrate the DVS face up if you will deploy the instrument face down).

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

i. Click the **Start Calibration** button to begin the calibration.

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

j. If the compass calibration fails, move to another location and try again. You may need to leave areas that contain computers and electronics and find an area with less electro/magnetic disturbances. You also may need to move the DVS through its rotations a bit slower.

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

3.8 Sealing the DVS for a Deployment

Use the Parts Location Drawings and the following steps to seal the DVS for a deployment.

a. Check the DVS electronics; there should be no loose screws or missing hardware.

b. Replace the battery pack or connect the battery cable (see DVS Battery Packs)

c. Add two fresh desiccant bags inside the DVS housing (see Desiccant Bags).

d. Install the transducer head assembly and end-cap (see DVS Re-assembly).

e. The DVS is now ready for deployment unless you want to take steps to prevent biofouling (see Prevention of Biofouling).

f. Use Testing the DVS to test the DVS before the deployment.

3.9 Prevention of Biofouling

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

Deep Water Deployments. Biofouling is not usually a problem in deep water (more than 100 meters). Soft-bodied organisms usually cause no problems. Do not apply antifouling paint if deploying the DVS in deep water.

Shallow Water Deployments. Soft-bodied organisms usually cause no problems, but barnacles can cut through the urethane transducer face causing failure to the transducer and leakage into the DVS (see Figure 31).

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

3.9.1 Controlling Biofouling

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

- Coat the entire DVS with antifouling paint. Make sure that the paint is applied in an even coat over the transducer faces and inductive modem (see Applying Antifouling Paints).
- Apply a thin coat (1 mm, 0.039 in.) of either a 50:50 mix of chili powder and petroleum jelly or chili powder and silicone grease to the transducer faces. The chili powder should be the hottest that can be found. Water flowing across the transducers will wash this mix away over time. The silicone mixture tends to last longer.
- If using antifouling grease, remove the grease immediately after recovering the DVS from its deployment. Remove the grease with soapy water. Be sure to wear protective gloves and a face shield.

CAUTION.

1. Antifouling grease is toxic. Read the product safety data sheet before using the grease. Wear gloves and a face shield when applying the grease. If the skin comes in contact with the grease, immediately wash the affected area with warm, soapy water.
2. All U.S. coastal states prohibit the use of tributyl-tins on boat hulls. The European Economic Commission has released a draft directive that would prohibit the use of many organo-tins after July 1989. We strongly recommend you obey your local laws.

3.9.2 Antifouling Paints

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

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

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

3.9.3 Applying Antifouling Paints

Apply an even, thin layer (0.1mm, 4mil per coat) of antifouling paint to the urethane faces.

> **CAUTION.** The DVS Operating frequency is ~2.4 MHz with a corresponding wavelength that is less than 1 mm. Until more field data can be gathered using various paints, **we recommend that any antifouling coating should be applied in as thin a layer as possible**. It should be understood that applying a coating may reduce the measurement range of the DVS (though it will not affect its accuracy in the measurable range).

a. Preparation – Clean thoroughly with soapy water. Dry completely.

b. Application - Apply one or two coats of antifouling paint at 0.1mm, 4mil 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 paint the white Delrin portions of the DVS end-cap, inductive modem, and transducer head. The paint will not stick to Delrin.

3.10 Thermistor Maintenance

In order to respond quickly to changes in the water temperature, water must be able to flow over the temperature sensor. Do not block the sensor. Remove any biofouling as soon as possible.

Clean the TRDI Thermistor

The TRDI thermistor is embedded in the transducer assembly. Biofouling may build up around the sensor, and eventually clog the sensor. To clean the sensor, wipe the temperature sensor with a clean soft cloth. Do not scratch or scrape the sensor.

> **NOTE.** The TRDI Thermistor is embedded in the transducer head. The sensor is under a stainless steel cover that is highly resistant to corrosion.

Clean the Sea-Bird Thermistor

The optional high resolution thermistor is surrounded by a plastic guard. Biofouling may build up around the guard, and eventually clog the sensor. If rinsing the sensor guard with water does not clear the biofouling, use a small brush no stiffer than a hand cleaning brush.

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

3.11 High Pressure Housings

The high pressure system allows you to deploy the DVS in depths of 6000 meters. The Outline Installation Drawings shows the dimensions and weights for all of the systems.

This section includes information on maintenance items for the high-pressure housing only.

3.11.1 High Pressure End-Cap Removal Procedures

To remove the end-cap, do the following steps. Use the Parts Location Drawings for parts identification.

a. Dry the outside of the DVS.

b. Lay the DVS on its side on a soft pad.

c. Remove all power to the DVS.

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

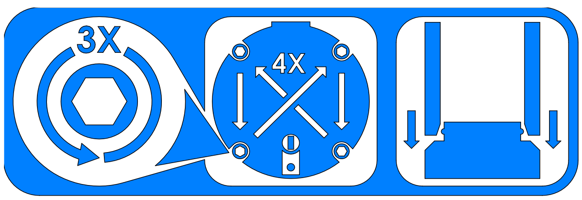


Figure 26. Instruction Label

NOTE. Do not loosen or remove the M4 hex nut.

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

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

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

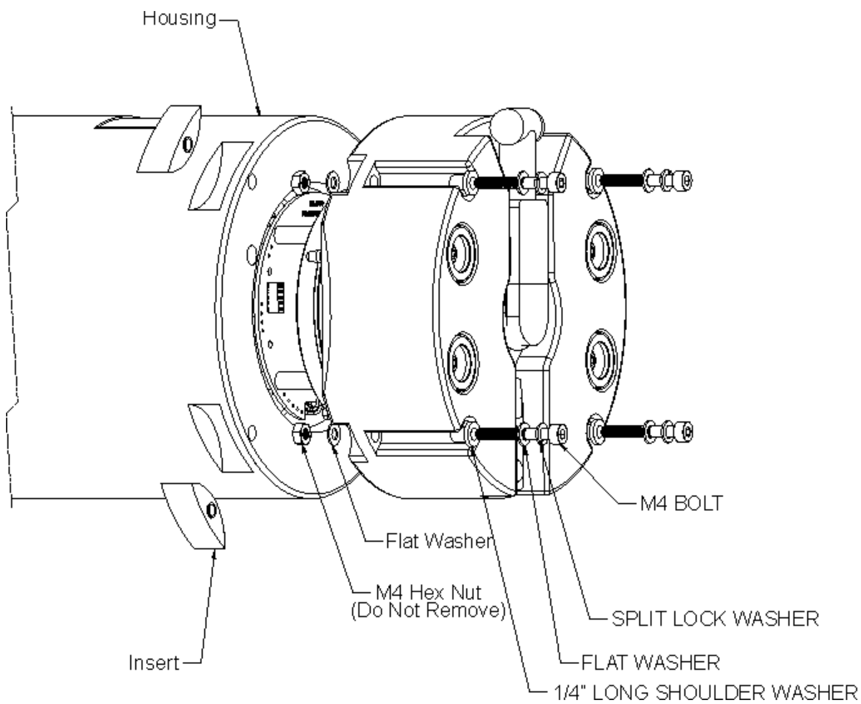


Figure 27. High Pressure End Cap Mounting Hardware

> **NOTE.** The end-cap hardware will stay attached to the end-cap.

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

h. 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 (see Figure 22).

i. Disconnect the tension cord (green wire).

j. Gently pull the end-cap and battery assembly away from the housing.

3.11.2 High Pressure End-Cap Replacement

> **NOTE.** If the transducer head assembly was removed, replace it first before installing the end-cap (see High Pressure Transducer Head Assembly Replacement).

a. Lay the DVS on its side on a soft pad.

b. Inspect, clean, and lubricate the O-ring on the end-cap/battery assembly (see O-Ring Inspection and Replacement).

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

c. Replace the desiccant bags just before sealing the housing (see Desiccant Bags).

d. Connect the tension cord (green wire).

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

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

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

NOTE. If you are not deploying the DVS within the next hour, use the DVS software to send the CZ command to put the DVS to sleep.

g. Slide the end-cap into the end-cap side of the housing making sure that the two banana-plugs seat properly into the housing (these plugs ensure the housing is electrically connected to the end-cap for anode protection). Make sure none of the cables become pinched or that the O-rings slip out of the groove.

CAUTION. Check that no wires or any other object is pinched between the end-cap and the housing. **If the O-rings are not in the groove or if a wire or other object is pinched, the DVS will flood.**

h. Examine the end-cap assembly nuts, bolts, and washers for corrosion; replace if necessary. All the hardware items are needed to seal the DVS properly.

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

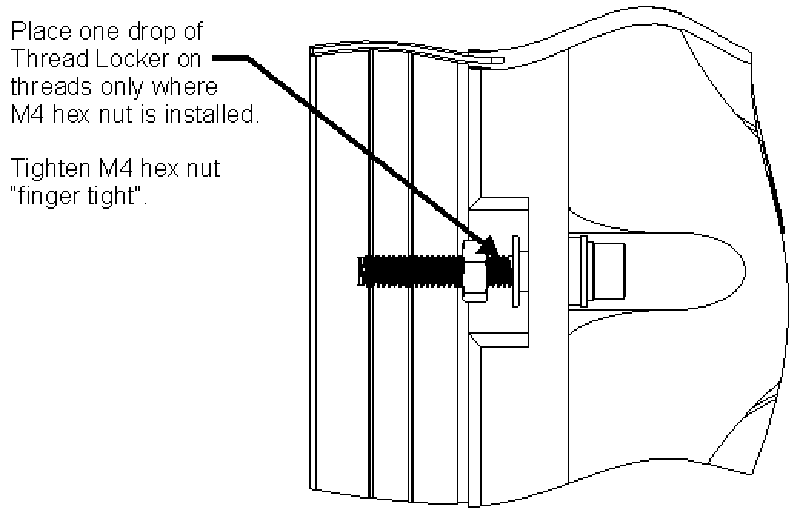


Figure 28. End-Cap Mounting Hardware Replacement

i. If the end-cap mounting hardware is replaced, apply one drop of thread locker to the M4 bolt only where the M4 nut is installed. Tighten the M4 nut "finger tight". Allow the thread locker to cure for 24 hours before deploying the DVS.

j. Check the inserts are not stripped or worn. Inserts snap into place with the metal thread portion facing the end-cap. Replace as necessary.

k. Tighten one bolt three full turns. Move to the next bolt in a "crisscross" pattern and tighten three turns. Repeat until all four bolts are tightened. As the bolts are tightened, the end-cap will seat into the housing.

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

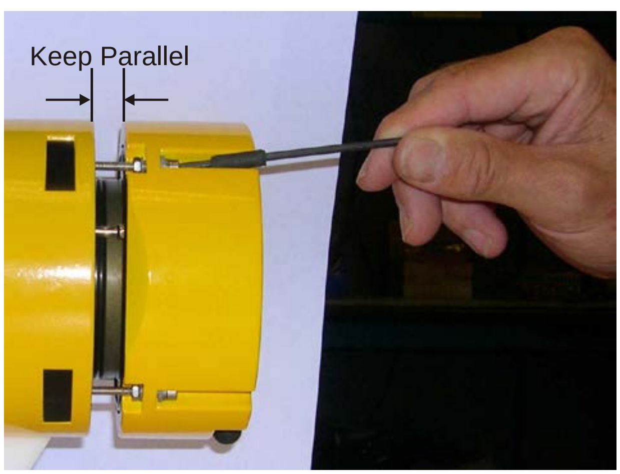


Figure 29. High Pressure End-Cap Replacement

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

CAUTION. Do not over tighten the bolts that hold the transducer, housing, and end cap together. Over-torqued bolts can strip or crack the end-cap. On the other hand, leaving the bolts too loose can cause the system to flood. **Tighten the hardware to the recommended torque value.**

NOTE. The recommended torque value for the end-cap 4-mm bolts is 1.2 ± 0.2 Newton-meters (10.62 ± 1.7 pound-inches).

3.11.3 High Pressure Transducer Head Assembly Removal

CAUTION. Normal maintenance does not require removing the transducer head. **Only use the following procedures if directed to do so by TRDI Field Service personnel.**

NOTE. When you need access to the DVS internal battery, remove the end-cap assembly (see High Pressure End-Cap Removal Procedures).

a. Remove all power to the DVS.
b. Lay the DVS on its side on a soft pad.
c. Remove the end-cap (see High Pressure End-Cap Removal Procedures).

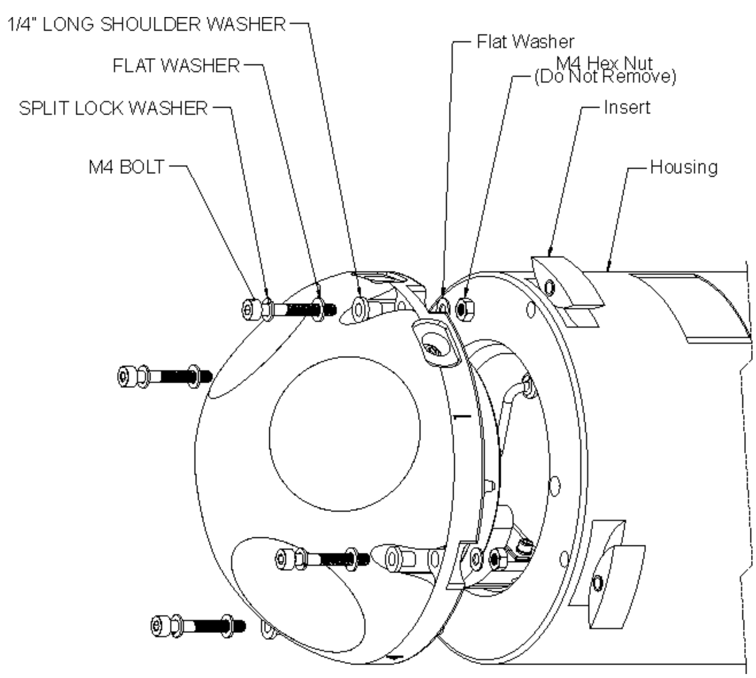


Figure 30. Transducer Head Mounting Hardware

d. Using an L-wrench only, loosen one of the M4 bolts three turns.

e. Move to the next bolt in a crisscross pattern and loosen that bolt three turns.

f. Observe that the transducer head 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 transducer head evenly.** As the bolts are loosened, the transducer head will be backed out away from the housing.

CAUTION. Failure to follow this procedure may cause damage to the DVS housing or transducer head.

NOTE. The hardware will stay attached to the transducer head.

g. Carefully slide out the transducer head assembly.

3.11.4 High Pressure Transducer Head Assembly Replacement

a. Lay the DVS on its side on a soft pad.

b. Inspect, clean, and lubricate the O-ring on the housing (see O-Ring Inspection and Replacement).

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

c. Replace the desiccant bags just before sealing the housing (see Desiccant Bags).

d. Gently slide the transducer head/electronics assembly into the housing, aligning the mating holes and the circuit boards are facing the same direction as shown in Figure 20 and making sure that the two banana-plugs seat properly into the housing (these plugs ensure the housing is electrically connected to the transducer for anode protection). When mating the housing with the transducer head flange, apply equal pressure to all parts of the O-ring. Make sure the O-rings remain in the retaining groove.

CAUTION. Check that no wires or any other object is pinched between the transducer head assembly and the housing. **If the O-ring is not in the groove or if a wire or other object is pinched, the DVS will flood.**

e. Examine the transducer assembly nuts, bolts, and washers for corrosion; replace if necessary. The Parts Location Drawings shows the assembly order of the transducer mounting hardware. All hardware items are needed to seal the DVS properly.

NOTE. 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 nut is installed (see Figure 28). Tighten the M4 nut "finger tight".

f. Check the inserts are not stripped or worn. Inserts snap into place with the metal thread portion facing the transducer. Replace as necessary.

g. Tighten one M4 bolt three full turns. Move to the next M4 bolt in a "crisscross" pattern and tighten three turns. Repeat until all four bolts are tightened. As the bolts are tightened, the transducer will seat into the housing.

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

CAUTION. Observe that the transducer head 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 transducer head evenly. **Failure to follow this procedure may cause damage to the DVS housing or transducer head.**

CAUTION. Do not over tighten the bolts that hold the transducer, housing, and end cap together. Over-torqued bolts can strip or crack the transducer head. On the other hand, leaving the bolts too loose can cause the system to flood. **Tighten the hardware to the recommended torque value.**

NOTE. The recommended torque value for the transducer head M4 bolts is 1.2 ± 0.2 Newton-meters (10.62 ± 1.7 pound-inches).

3.11.5 Zinc Anode Inspection and Replacement

High-pressure 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 help protect the DVS from corrosion while deployed. Read all instructions before doing the required actions.

Zinc Anode Inspection

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

a. Inspect the anodes on the transducer assembly and end-cap for corrosion and pitting. If most of an anode still exists, you may not want to replace it.

b. Inspect the RTV-covered screws that fasten each anode. If the RTV has decayed enough to let water enter between the screws and the anode, replace the RTV.

c. If you have doubts about the condition of the anodes, remove and replace the anode.

Zinc Anode Electrical Continuity Check

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

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

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

Zinc Anode Replacement

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

a. Remove the RTV from the anode screw heads. Remove the screws.

b. The anode may stick to the DVS because of the RTV used during assembly. To break this bond, first place a block of wood on the edge of the anode to protect the housing anodizing and paint. Carefully strike the block to loosen the anode.

c. Clean the bonding area under the anode. Remove all foreign matter and corrosion. Apply a continuous 1 to 2 mm bead (0.04 to 0.08 in.) of RTV around each screw hole.

d. Set a new anode in place and fasten with new screws.

e. Fill the counter bore above each screw head with RTV. The RTV protects the screw heads from water and prevents breaking the electrical continuity between the anode, screw, and housing.

f. Check electrical continuity. If any measurement is greater than one ohm, reinstall the affected anode.

CAUTION.

1. Do not use zinc anodes with an iron content of more than 0.0015%. The major factor controlling the electrical current output characteristics of zinc in seawater is the corrosion film that forms on the surface of the zinc. Corrosion product films containing iron have a high electrical resistance. As little as 0.002% iron in zinc anodes degrades the performance of the anode.

2. Do not use magnesium anodes. Magnesium rapidly corrodes the aluminum housing.

3. Do not connect other metal to the DVS. Other metals may cause corrosion damage. Use isolating bushings when mounting the DVS to a metal structure.

3.11.6 Protective Coating Inspection and Repair

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

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

a. Inspect the 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 (yellow). Be critical in your judgment; the useful life of the DVS depends on it.

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

b. If you are familiar with the repair of anodized coatings, proceed as follows; otherwise, send the DVS to TRDI for repair.

1. Clean and prepare the damaged area using a fine-grade abrasive cloth or a fine-grade abrasive silicon carbide wheel. Remove all corrosion from the bare aluminum.
2. Clean the area with alcohol. Do not touch the area after cleaning.
3. Anodize per MIL-A-8625, Type 3, Class 1.
4. Seal with sodium dichromate only.
5. Paint repaired area as described in step c below.

c. Proceed as follows to repair or touch up the protective paint.

1. Remove all loose paint without damaging the anodizing. Clean and prepare the damaged area using a fine-grade abrasive cloth. Feather the edges of the paint near the damaged area. Try to have a smooth transition between the paint and the damaged area. Do not sand the anodized area. If you damage the anodizing, see step b above for repair.
2. Clean the area with alcohol. Do not touch the area after cleaning.
3. Paint with one coat of epoxy primer (see note below).
4. Paint with one coat of yellow paint (see note below).

> **NOTE.** TRDI uses two-part epoxy type paint. This paint is manufactured by Sherwin –Williams Proline Paint Store, 2426 Main St., San Diego, CA, 92113-3613, Telephone: +1 (619) 231-2313.
>
> Manufacturer's part numbers:
> 340-hp, Catalyst,
> 4800-19, Yellow
>
> Contact the paint manufacturer for preparation and application procedures for this and other paints. Contacting this company is done with the knowledge that Teledyne RD Instruments is not recommending them, but only offering this as a source for the paint.

3.12 Storage and Shipping Maintenance

This section lists the maintenance items to do before storing the DVS. These maintenance items include:

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

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

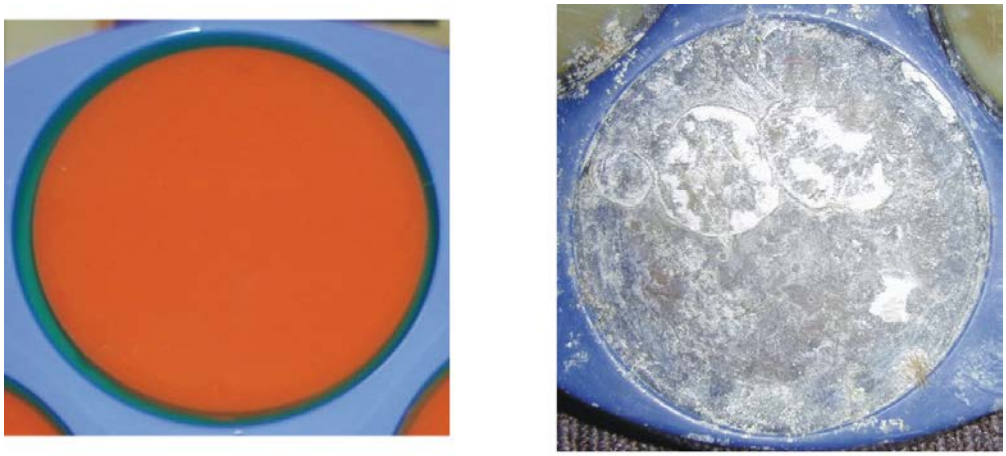
⚠	**CAUTION.** If the DVS has an external I/O connector, clean and inspect the I/O connector for water or salt residue. Make sure the dummy plug is installed to protect the connector.

3.12.1 Removal of Biofouling

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.

⚠	**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.

If there is heavy fouling or marine growth, the transducer faces may need a thorough cleaning to restore acoustic performance. Barnacles do not usually affect DVS operation. We do however recommend removal of the barnacles to prevent water leakage through the transducer face. Lime dissolving liquids such as Lime-Away® break down the shell-like parts. Scrubbing with a medium stiffness brush usually removes the soft-bodied parts. Do NOT use a brush stiffer than a hand cleaning brush. Scrubbing, alternated with soaking in Lime-Away®, effectively removes large barnacles. After using Lime-Away®, rinse the DVS with fresh water to remove all residues. If barnacles have entered more than 1.0 to 1.5 mm (0.06 in.) into the transducer face urethane, you should send the DVS to TRDI for repair (see Figure 31). If you do not think you can remove barnacles without damaging the transducer faces, contact TRDI.



BEFORE AFTER

Figure 31. Barnacle Damage

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

3.12.2 Transducer Head Inspection

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

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

3.12.3 Final Storage or Shipping Preparation

This section explains how to store or ship the DVS.

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

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

NOTE. TRDI strongly recommends using the original shipping crate whenever transporting the DVS.

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

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

a. Use a strong shipping container made out of wood or plastic.

b. Install a layer of shock-absorbing static-shielding material, 70-mm to 100-mm thick, around all sides of the instrument to firmly cushion and prevent movement inside the container.

c. Seal the shipping container securely.

d. Mark the container FRAGILE to ensure careful handing.

e. In any correspondence, refer to the DVS by model and serial number.

3.13 Parts Location Drawings

Use the following figures to identify the parts used on your DVS.

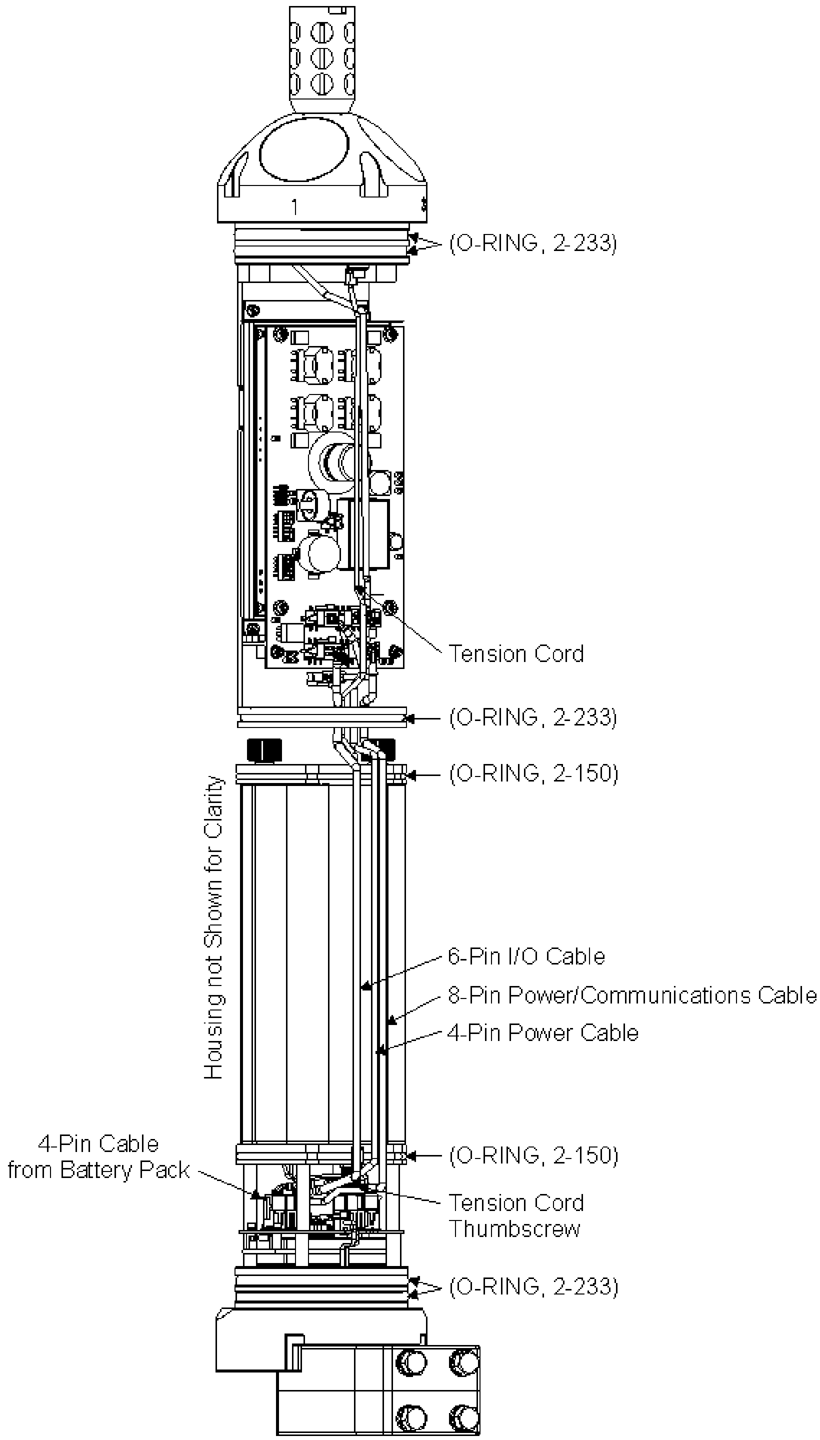


Figure 32. DVS Internal Parts Overview (Standard 750 meter System)

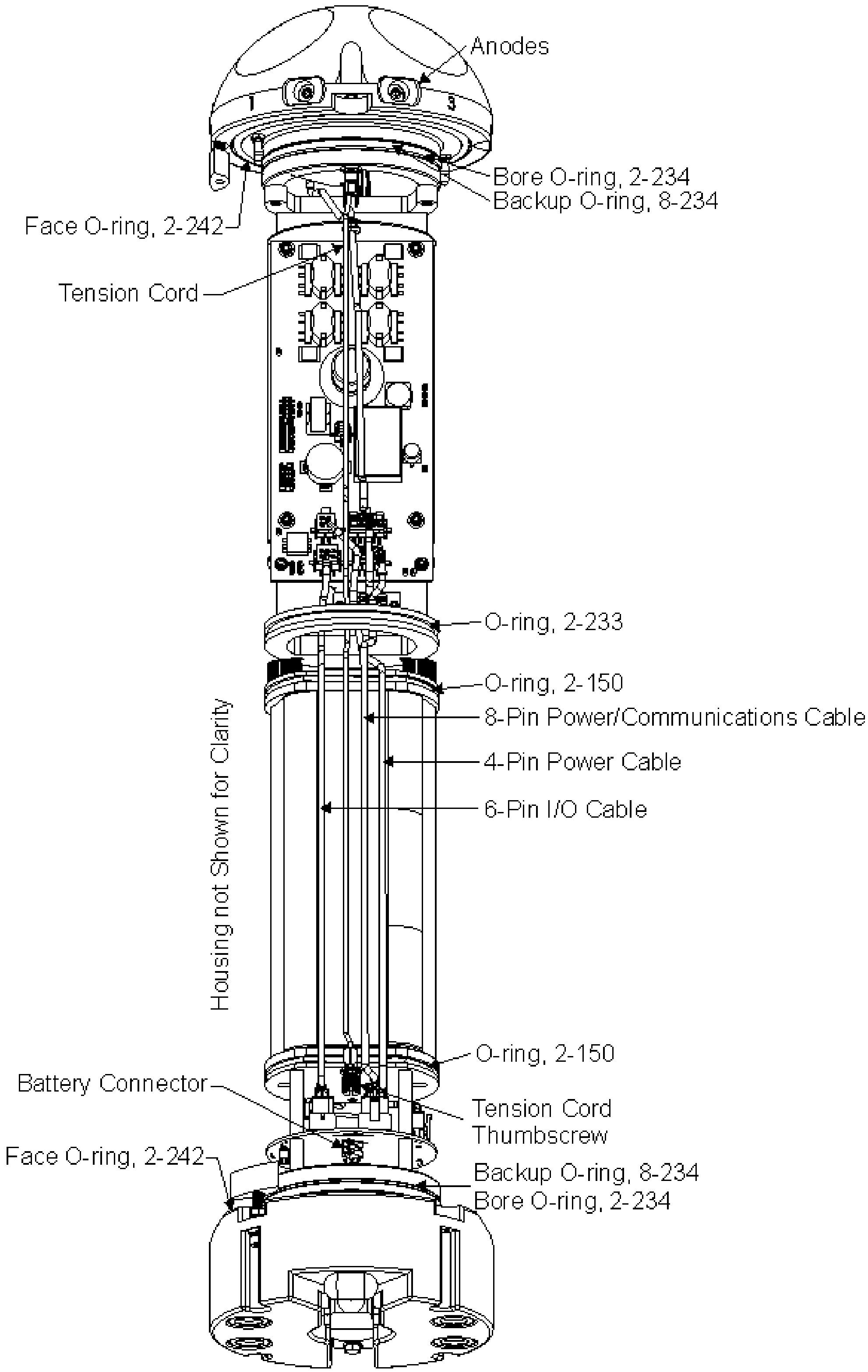


Figure 33. DVS Internal Parts Overview (6000 meter System)

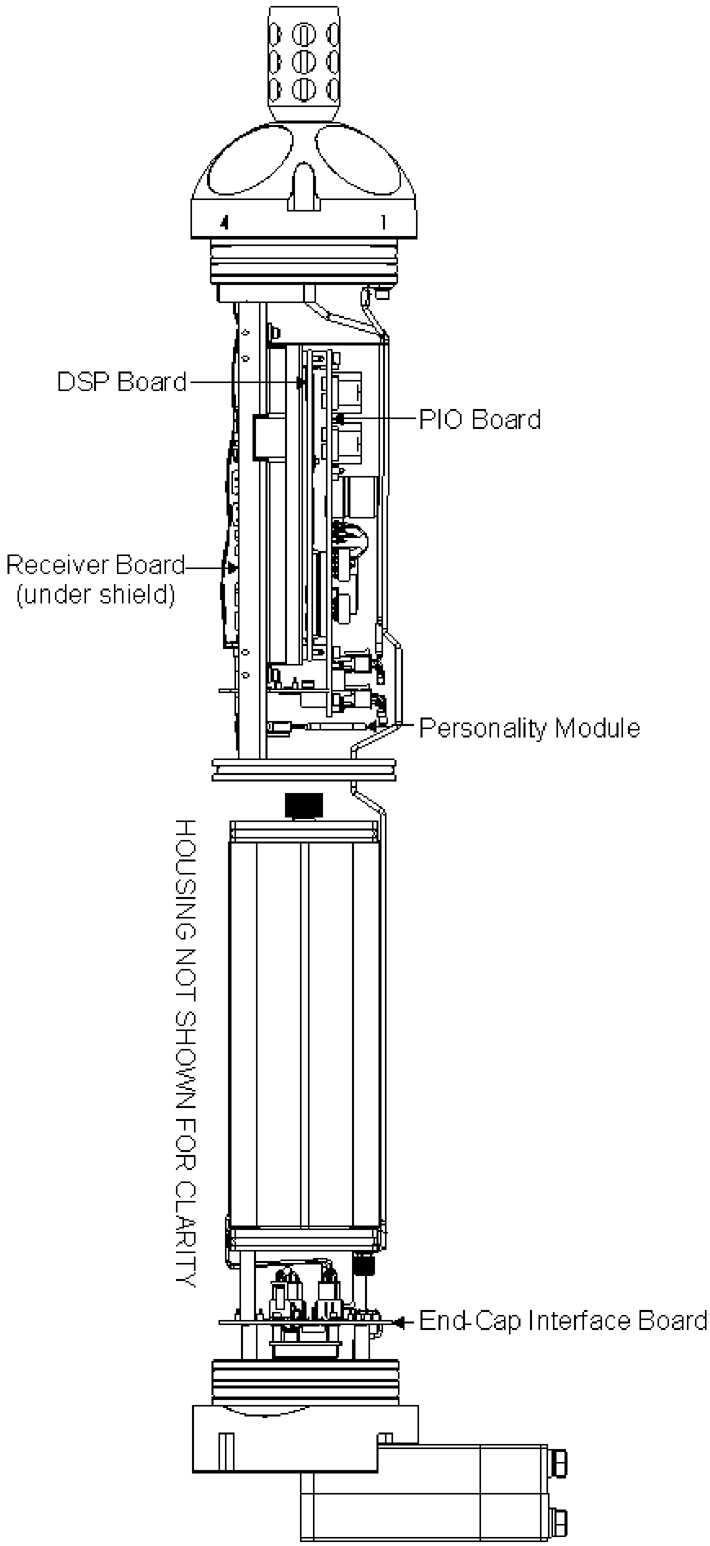


Figure 34. DVS Board Locations

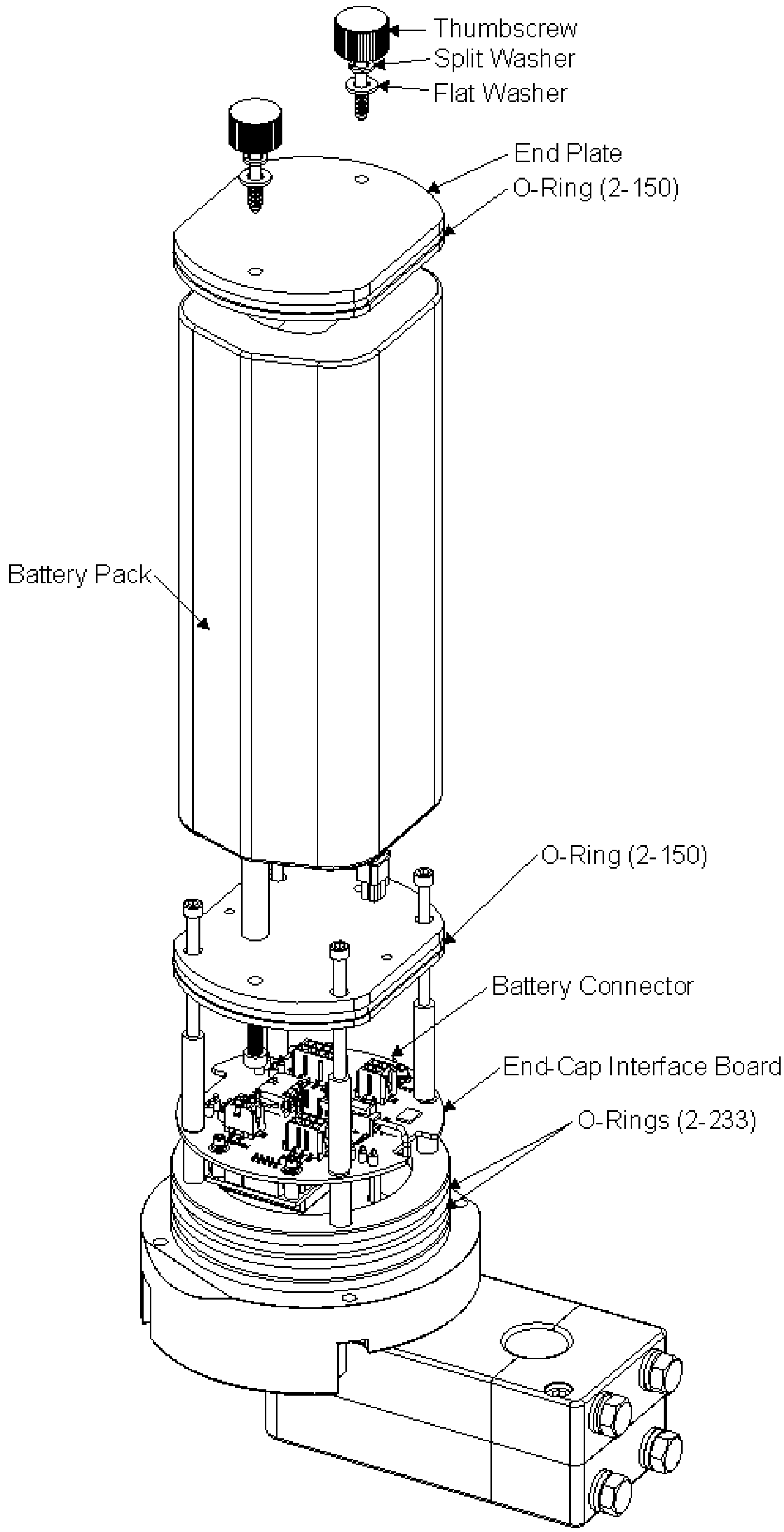


Figure 35. End-cap and Battery Pack Parts Location (Standard 750 meter System)

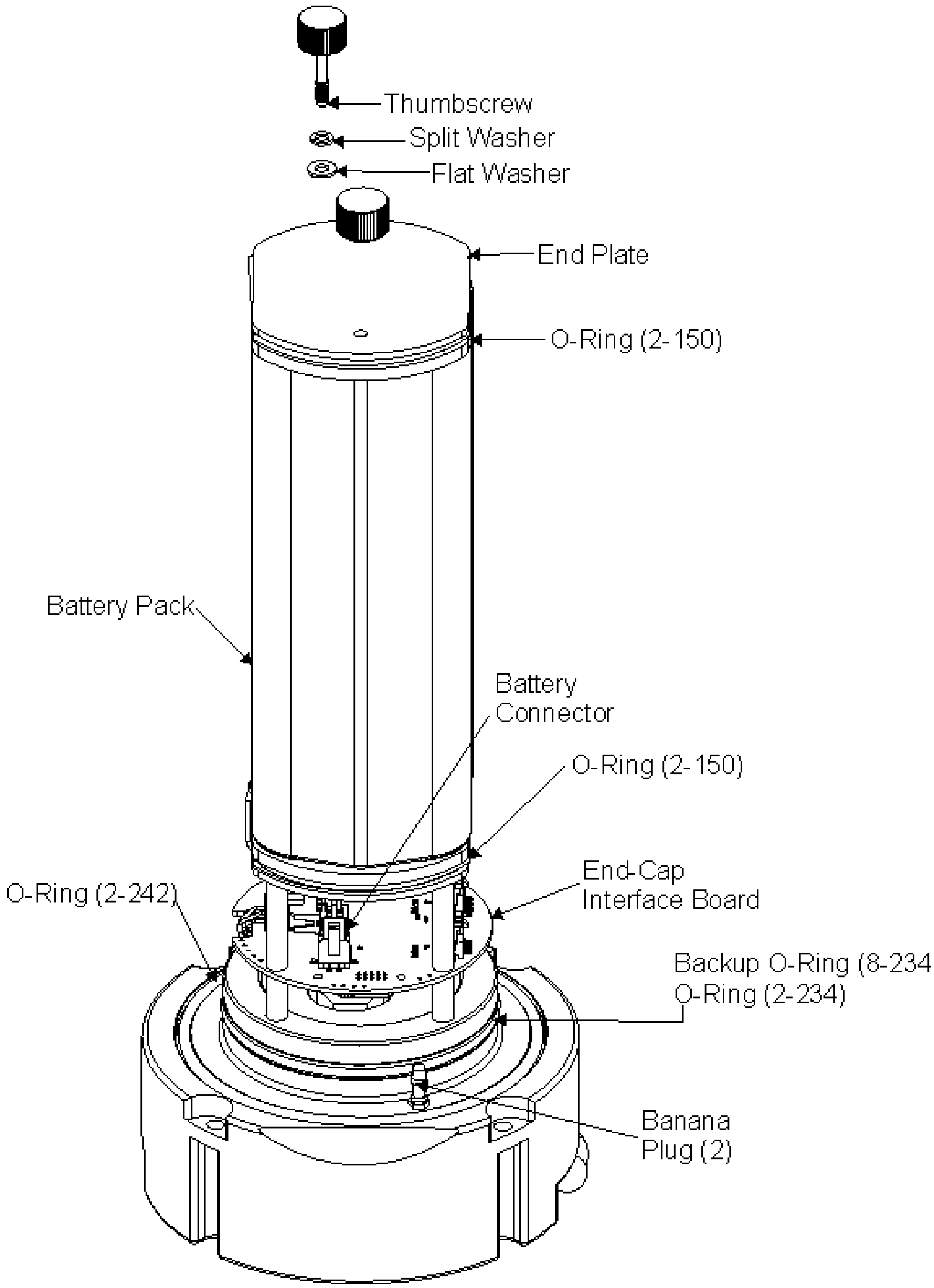


Figure 36. End-cap and Battery Pack Parts Location (6000 meter System)

4 Testing the DVS

This section explains how to test the DVS using the *DVS* program. These tests thoroughly check the DVS in a laboratory environment, but are no substitute for a practice deployment. You should test the DVS:

- When you first receive the DVS.
- Before each deployment or every six months.
- When you suspect instrument problems.
- After each deployment.

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

4.1 Test Setup – End-Cap Connector

For DVS systems with the end-cap connector, use the following procedure to connect the DVS to a computer.

a. Remove the dummy plug from the end-cap and connect the I/O cable to the DVS end-cap (see I/O Cable and Dummy Plug).

b. 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.

c. Connect the I/O cable red/black banana plugs to an external power supply (+ 10.8 to 28 VDC) or connect the internal battery red/black cable.

> **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).

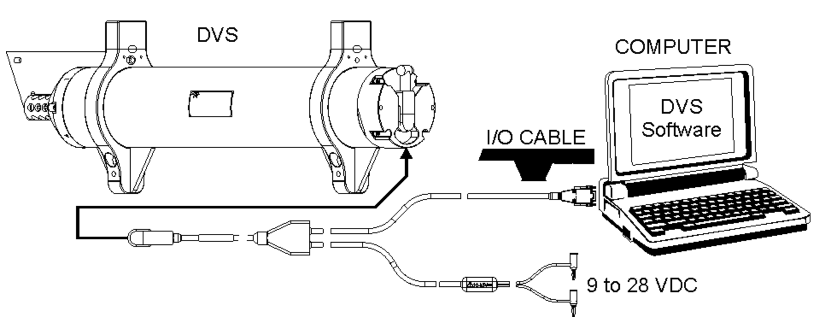


Figure 37. Test Setup – End-Cap with Connector

4.2 Test Setup – Inductive Modem

Most testing and data download 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).

a. Remove the end-cap far enough to allow access to the cables (see End-Cap Removal Procedures).

b. Connect the 6-pin test cable to the End-Cap Interface board (see Figure 38).

c. 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.

d. Connect the test cable red/black banana plugs to an external power supply (+ 10.8 to 28 VDC) or connect the internal battery red/black cable.

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).

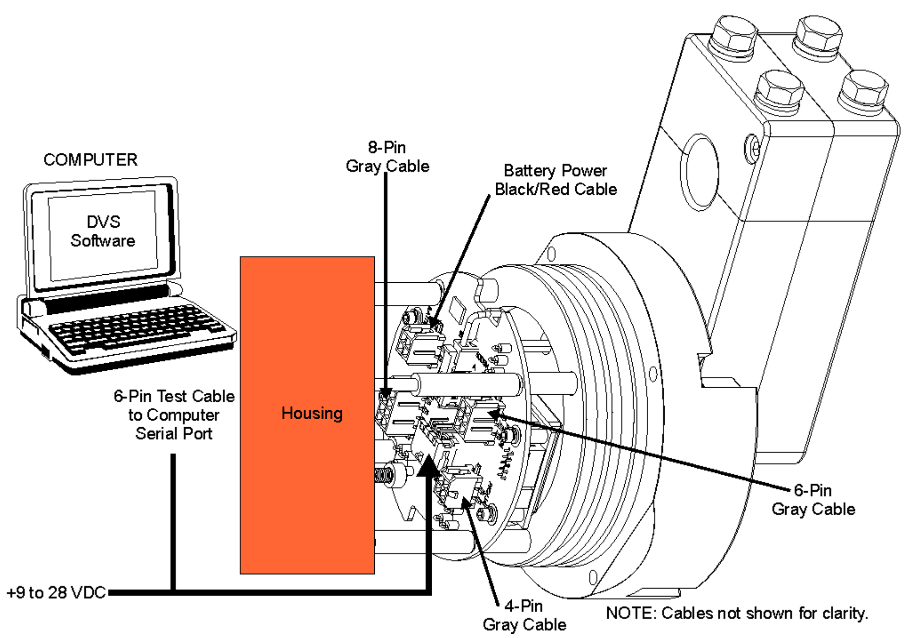


Figure 38. Test Setup – Inductive Modem End-Cap

4.3 Using the DVS Software

Before a DVS unit it is deployed, the unit needs to be tested.

4.3.1 Run the DVS Tests

Use the following steps to test the DVS.

a. Connect and power up the DVS unit as shown in Figure 37 or Figure 38.

b. Start the *DVS* program.

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

d. On the **Test DVS** screen, select **Run All Tests** (includes the recorder test) or **Run Individual Tests** and select the desired tests. Click the **Start Test** button. The selected tests will run (see Performance and Testing Commands 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.

e. The results of the test will be displayed in the **Terminal Window** area and saved to the log file (*.log) if the **Log result to file** box is selected.

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

g. When done testing, put the DVS to sleep (see Putting the DVS to Sleep).

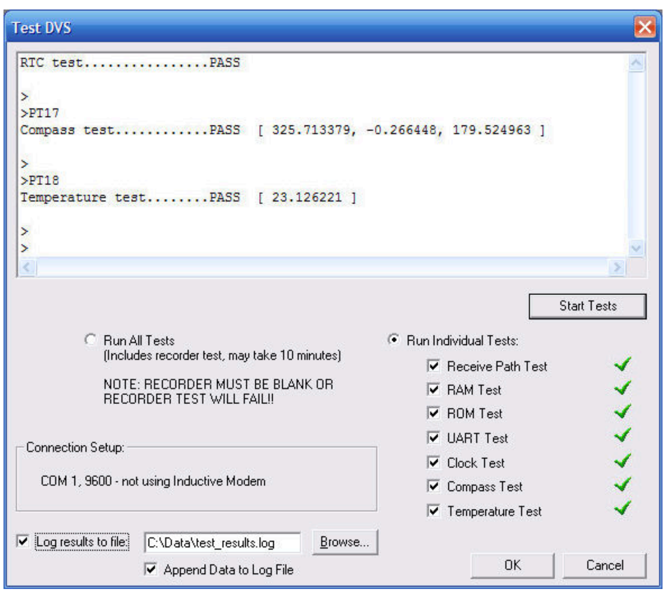


Figure 39. Testing the DVS

4.3.2 Using the DVS Software Terminal Screen

Use the DVS terminal screen to send any command to the DVS unit. The commands are listed on the left hand side of the window. Selecting any of the commands will display a definition of its use on the right-hand side, with options to choose parameters depending on the command.

> **NOTE.** Some commands can not be sent via the inductive modem, specifically PC*x* (Built-in tests) can not be sent via the inductive modem because the modem can not support the data rate of the sensor output from this command.

a. Connect and power up the DVS unit as shown in Figure 37 or Figure 38.

b. Start the *DVS* program.

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

d. On the **Tools** menu, click **Terminal**.

e. Click **Send Break** to wakeup the DVS unit. For every break sent, you should see the wakeup message.

f. Select the name of the command and parameters to be run. Click the **Send** button. See Introduction to Commands for descriptions of all the test commands available.

g. When done, put the DVS to sleep (see Putting the DVS to Sleep).

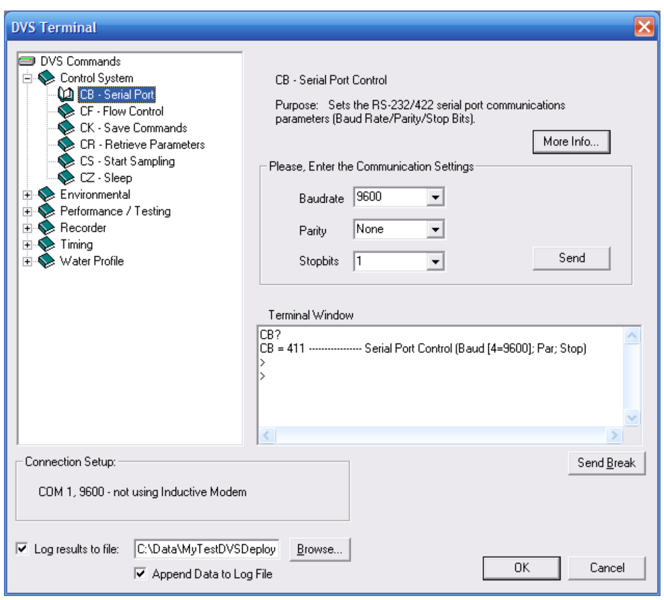


Figure 40. DVS Terminal Screen

4.3.3 Putting the DVS to Sleep

If you do not wish to deploy the DVS immediately, be sure to send a CZ command to put the DVS to sleep. When the DVS is sleeping, it uses minimal battery power. To put the DVS to sleep, do the following.

a. Use the **DVS Terminal** screen and select the **CZ – Sleep** command under the **Control System** command list.

b. Click the **Send** button.

c. Verify the *DVS powering down* message appears.

NOTE. Disconnecting the internal battery when the end-cap is opened will ensure the battery power is conserved.

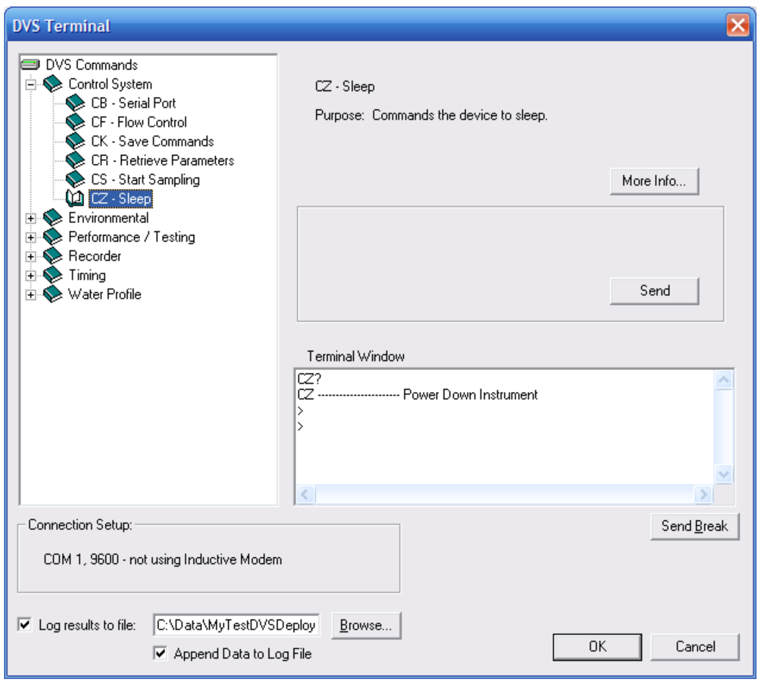


Figure 41. Putting the DVS to Sleep

NOTE. By default, the activity timer set by the CA command is set to 120 seconds (see CA – Communication Timeout) and the CT command is ON (see CT – Turnkey Mode). This means that the DVS will start pinging after 120 seconds if no command is sent.

CAUTION. If you do not use the CZ-command, the DVS will deploy with what ever commands are presently set. If you leave the DVS running a sensor test under battery power, a *new battery will be discharged in a few days*.

4.3.4 Check the Recorder Status

Use the **Check Recorder Status** functions to see how much memory is used on the recorder.

a. Connect and power up the DVS unit as shown in Figure 37 or Figure 38.

b. Start the *DVS* software.

c. On the **Tools** menu, click **Recorder Status**. This will open **Recorder Status** screen (see Figure 42).

d. Click the **Get Status** button. The *DVS* software sends the MM command to the DVS and will display the number of bytes used and free on the recorder in the **Recorder Status** area (see MM – Show Memory Usage).

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

f. Click **OK** to exit the **Recorder Status** screen.

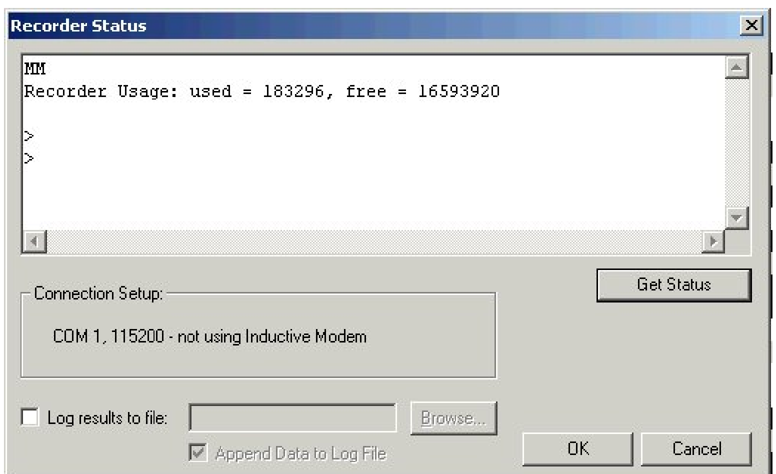


Figure 42. Recorder Status

5 Troubleshooting

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

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

Table 11: List of Least Replaceable Assemblies

LRA	Description
DVS	The entire DVS; includes the electronics, housing, transducer ceramic assemblies, and end-cap.
Test Cable	Connects the DVS with the Computer.
End-Cap	Includes the end-cap and inductive modem or underwater connector.

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

5.1 Equipment Required

Special test equipment is not needed for trouble shooting and fault isolation. The required equipment is listed in Table 12. Any equipment satisfying the critical specification listed may be used.

Table 12: Required Test Equipment

Required Test Equipment	Critical Specification
DMM	Resolution: 3 ½ digit
	DC-Voltage Range: 200 mV, 2V, 20 V, 200V
	DC-Voltage Accuracy: ± 1%
	AC-Voltage Range: 200 V, 450 V
	AC-Voltage Accuracy: ± 2%
	Resistance Range: 200, 2 k, 20 k, 200 k, 20 MOhm
	Res.-Accuracy: ± 2% @ 200 Ohm to 200 kOhm
	Res.-Accuracy: ± 5% @ 20 Mohm
	Capacitance Range: 20 nF, 2 uF, 20 uF
	Capacitance Accuracy: ± 5%

Required Test Equipment	Critical Specification
Serial Data EIA Break-Out Box such as from International Data Sciences, Inc. 475 Jefferson Boulevard Warwick, RI 02886-1317 USA.	Model 60 or similar is recommended as it eases the troubleshooting of RS-232 communication problems significantly. Other manufacturers or models may be substituted.

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

5.2 Basic Steps in Troubleshooting

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

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

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

Built-In test failures will appear when the system diagnostics are run. Use the DVS software to identify the failing test.

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

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

5.3 Troubleshooting the DVS

Although the DVS is designed for maximum reliability, it is possible for a fault to occur. This section explains how to troubleshoot and fault isolate problems to the Least Replaceable Assembly level (see Table 11). Before troubleshooting, review the procedures, figures, and tables in this guide. Also, read the System Overview to understand how the DVS processes data.

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

5.3.1 Troubleshooting Safety

Follow all safety rules while troubleshooting.

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

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

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

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

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

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

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

5.4 Troubleshooting a Communication Failure

DVS units communicate by means of RS-232 serial communication. The user can choose between the inductive modem and the RS-232 port. Communication using the RS-232 port can only be accomplished via the test cable with the end cap disconnected for DVS units with the inductive modem.

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

There are two types of communication failures; nothing happens at all when attempting to wake up the DVS or something happens, but not the correct wake up message is displayed.

5.4.1 Incorrect Wakeup Message

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

- Sending a break causes “garbage” to appear on the screen. The “garbage” text may keep scrolling. This happens when the computer is using RS-422 and the DVS is using RS-232.
- Sending a break causes “garbage” to appear on the screen. The “garbage” text does not keep scrolling. Check that the DVS and computer are both using the same baud rate. See the CB-command.
- When power is applied, the “>” prompt appears on the screen, and an “X” appears when additional breaks are sent, this may indicate that the boot code has been lost (see DVS Checks). This can happen if you abort while downloading new firmware. Try downloading the firmware again.

5.4.2 No Wakeup Message

If you cannot talk to the DVS (i.e., no wakeup message at all), you need to isolate the problem to a computer fault, power, cable failure, inductive modem, or a DVS problem. Check the following items:

a. Connect and power up the DVS unit as shown in Figure 37 or Figure 38. Check that all cable connections are tight.

b. If the DVS is running from the battery, disconnect the battery and use an external power supply (10.8 to 28 VDC).

c. Is the computer hooked up properly? Does it have power?

d. Make sure that your computer and the *DVS* program are set up to use the communication port the serial cable is connected to on the computer.

5.4.3 Check the Power

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

Check the power going into the DVS by measuring the voltage on the end of the cable that connects to the DVS at VIN+ and VIN- (GND) (see DVS Cables). The voltage should be +9 to 28 VDC (using an external power supply).

5.4.4 Check the Test Cable

This test will check the communication between the computer and DVS.

a. Disconnect both ends of the cable and measure the continuity using a DMM (see DVS Cables for the wiring diagram). Correct any problems found.

a. Reconnect the test cable to host computer.

a. Start the *DVS* program on your computer. Select the proper communications port (see the DVS Software User's Guide for help on using *DVS*).

b. Short TX1A and RX1A together on the cable connector that was plugged into the DVS (see DVS Cables).

c. Type any characters on the keyboard. The keys you type should be echoed on the screen. If you see characters, but not correctly (garbage), the cable may be too long for the baud rate. Try a lower baud rate. If this works disconnect the jumper and then push any keys on the keyboard. You should NOT see anything you type.

d. If the keys are echoed correctly on the screen, the computer and the communication cable are good. Re-connect the test cable to the DVS. The above loop-back test does not show if transmit and receive pairs are interchanged. Thus, it is important that you check the wiring diagrams provided in DVS Cables.

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

5.4.5 DVS Checks

Once you have eliminated possible problems with the power, test cable, communications settings, and the computer, that leaves the DVS as the source of the problem. If possible, remove the end-cap (see DVS Disassembly). Check for any loose cables. Contact our field service for further troubleshooting (see Technical Support).

5.5 Verifying Modem Communications

This section will describe how to verify that communications between the PC and each of the IMM's is configured and working correctly. There are three verification steps described below. These steps can be helpful in trouble-shooting communication problems.

NOTE. The steps described in this section utilize the *HyperTerminal* application, which is installed by default on *Windows* operating system.

a. To launch *HyperTerminal*, go to **Start**, **Programs**, **Accessories**, **Communications**, **HyperTerminal**.

b. Enter the serial communications settings by selecting the COM port (the port that the surface IMM is connected to) and entering the baud rate (9600), Data Bits (8), Parity (None) and Flow control (None).

c. Because the *DVS* software configures the modems to not echo back typed characters, set *HyperTerminal* to echo back the characters you type locally. To enable this setting, select **File**, **Properties**. Click the **Settings** tab and then click the **ASCII Setup** button.

d. Within the **ASCII Sending** section, check the **Echo typed characters locally** box, and click **OK** to save.

e. Click **OK** again to save close the properties dialog.

5.5.1 Verify Communication with Surface IMM

To verify that you can communicate with the surface IMM from *HyperTerminal*, type the following command into the HyperTerminal window:

```
getcd<ctrl-M><ctrl-J>
```

Note that you need to enter the carriage return (<ctrl-M>) and line feed (<ctrl-J>) characters manually. To enter a carriage return (<ctrl-M>), hold down the **Ctrl** key on the keyboard while typing the **M** key. To enter a line feed (<ctrl-J>), hold down the **Ctrl** key on the keyboard while typing the **J** key.

After sending this command, the surface modem should respond with a listing of the current configuration settings. An example of the expected response from the modem is show below:

```
<ConfigurationData DeviceType='SBE90554 IMM'
SerialNumber='70000044'>
<Settings ConfigType='2'
DebugLevel='0'
…
…
…

</ConfigurationData>
```

NOTE. See Surface IMM Settings For a complete list of surface IMM settings

If you do not get a similar response from the surface IMM, check that your serial connection is configured correctly, and that power has been applied to the surface IMM.

5.5.2 Verify Communication with DVS IMM

In order to establish communications beyond the surface modem, you need to capture the line. To do this, send the following command:

```
forcecaptureline<ctrl-M><ctrl-J>
```

There should be no response to this command. If an error is returned you will need to re-type the forcecaptureline command.

```
<Error type='INVALID COMMAND' msg='Not Recognized'/>
```

To communicate with the DVS IMM, you will need to specify the IMM ID. If you do not know the DVS IMM ID, type the following command in HyperTerminal:

```
id?<ctrl-M><ctrl-J>
```

The surface modem will respond with the ID of the DVS modem, i.e.:

```
id = 43
```

> **NOTE.** This command will only work in a setup where the DVS is the only device on the line below the surface modem.

If no commands are sent to the surface modem for a two minute time period, the following message will come back from the surface IMM:

```
<HostService2MinTimeout/>
```

When this occurs, you will need to repeat the forcecaptureline process described above before sending any further commands.

To send a command to the DVS modem, you need to precede the command with an exclamation mark (!) and the 2-digit IMM ID. To verify that the PC is communicating with the DVS modem, type the following command (where 43 is the DVS IMM ID returned from the id? command) into *HyperTerminal*:

```
!43getcd<ctrl-M><ctrl-J>
```

You should get a response showing the current DVS IMM settings, i.e.:

```
<ConfigurationData DeviceType='SBE90554 IMM'
SerialNumber='70000028'>
<Settings ConfigType='2'
DebugLevel='0'
…
…
…
</ConfigurationData>
```

> **NOTE.** See DVS IMM Settings for a complete list of DVS IMM settings.

If you cannot communicate with the DVS modem, check the connection between the surface IMM and the DVS device.

5.5.3 Verify Communication with DVS Device

To send a command through the two modems to the DVS device, you need to precede commands with a hash symbol (#). DVS commands require that an extra carriage return be appended to the command as well.

Before sending commands to the DVS over through the modem interface, you need to get the device's attention. To accomplish this, send the following commands through *HyperTerminal*:

```
!43sendbreak<ctrl-M><ctrl-J>
#43===<ctrl-M><ctrl-M><ctrl-J> (
```

NOTE. Note the extra <ctrl-M> in the #43 line and where 43 is the DVS IMM ID.

The first command tells the IMM to send a break to the DVS device. There should be no response to this command. The second command sends a soft break (===) command to the DVS device. After a brief pause, the DVS IMM should respond with:

```
<Error type='TIMEOUT' msg='THost2: Max Wait for Start ofReply'/>
```

This is the expected reply, as the DVS device will not output any data over the IMM interface after a soft break. The final step to get the DVS device's attention over the IMM is to send another break by typing:

```
!43sendbreak<ctrl-M><ctrl-J>
```

There should be no response to this command. To query a DVS device for the list of available commands, type the following into *HyperTerminal*:

```
#43?<ctrl-M><ctrl-M><ctrl-J>        Note the extra <ctrl-M>.
```

The DVS device should respond with a list of the available command categories, i.e.:

```
Available Commands:
C ----------------------- Control Commands
E ----------------------- Environment Commands
M ----------------------- Loop Recorder Commands
P ----------------------- Performance Test Commands
S ----------------------- Sensor Control
T ----------------------- Time Commands
Y ----------------------- Display Banner
W ----------------------- Water Profiling Commands
? ----------------------- Display Main Menu
>
```

To send the **MM** command to the DVS, type:

```
#43MM<ctrl-M><ctrl-M><ctrl-J>       Note the extra <ctrl-M>
```

If you cannot successfully send commands to the DVS, verify that both modems have been successfully configured from the *DVS* software, and that the connections from the PC to the surface IMM and from the surface IMM to the DVS device are in place, and that the DVS device is powered up.

5.5.4 Surface IMM Settings

Below are the hardware data settings for the surface IMM (i.e. the response to the gethd command):

```
<HardwareData
DeviceType='SBE90554 IMM' SerialNumber='70000044'>
<Manufacturer>Sea-Bird Electronics, Inc</Manufacturer>
<HardwareVersion>41420C.1</HardwareVersion>
<HardwareVersion>PCB Type 1, 10345</HardwareVersion>
<MfgDate>Apr  6 2006</MfgDate>
<FirmwareVersion>IMM Ver 1.05</FirmwareVersion>
<FirmwareDate>Apr  6 2007</FirmwareDate>
</HardwareData>
```

Note that the firmware version is 1.05. This is the only Sea-Bird firmware version that the DVS software has been tested with.

Below are the configuration data settings for the surface IMM (i.e. the response to the getcd command):

```
<ConfigurationData DeviceType='SBE90554 IMM' SerialNumber='70000044'>
<Settings ConfigType='2'
DebugLevel='0'
BaudRate='9600'
HostID='Host ID not set'
GdataStr='GDATA'
HostPrompt='x'
ModemPrompt='IMM>'
DeviceID='0'
EnableHostFlagWakeup='0'
EnableHostFlagConfirm='0'
EnableHostFlagTerm='0'
EnableSerialIMMWakeup='1'
EnableHostPromptConfirm='1'
EnableHostServeOnPwrup='1'
EnableAutoIMFlag='1'
EnablePrompt='0'
EnableHostWakeupCR='0'
EnableHostWakeupBreak='0'
EnableEcho='0'
EnableSignalDetector='1'
EnableToneDetect='0'
EnableFullPwrTX='0'
EnableBackSpace='1'
EnableGDataToSample='0'
EnableStripHostEcho='0'
EnableBinaryData='1'
SerialType='1'
TermToHost='255'
TermFromHost='254'
SerialBreakLen='50'
MaxNumSamples='40'
GroupNumber='0'
THOST0='0'
THOST1='5'
THOST2='1000'
THOST3='12000'
THOST4='500'
THOST5='5'
TMODEM2='500'
TMODEM3='15000'
/>
</ConfigurationData>
```

Note that the serial number and device ID will vary by device.

5.5.5 DVS IMM Settings

Below are the hardware data settings for the DVS IMM (i.e. the response to the gethd command):

```
<HardwareData
DeviceType='SBE90554 IMM' SerialNumber='70000028'>
<Manufacturer>Sea-Bird Electronics, Inc</Manufacturer>
<HardwareVersion>41420C.1</HardwareVersion>
<HardwareVersion>PCB Type 1, 10345</HardwareVersion>
<MfgDate>Apr  6 2006</MfgDate>
<FirmwareVersion>IMM Ver 1.05</FirmwareVersion>
<FirmwareDate>Apr  6 2007</FirmwareDate>
</HardwareData>
```

Note that the serial number will vary by device.

Below are the configuration data settings for the DVS IMM (i.e. the response to the getcd command):

```
<ConfigurationData DeviceType='SBE90554 IMM' SerialNumber='70000028'>
<Settings ConfigType='2'
DebugLevel='0'
BaudRate='9600'
HostID='Host ID not set'
GdataStr='GDATA'
HostPrompt='x'
ModemPrompt='IMM>'
DeviceID='43'
EnableHostFlagWakeup='0'
EnableHostFlagConfirm='0'
EnableHostFlagTerm='0'
EnableSerialIMMWakeup='0'
EnableHostPromptConfirm='0'
EnableHostServeOnPwrup='0'
EnableAutoIMFlag='1'
EnablePrompt='0'
EnableHostWakeupCR='0'
EnableHostWakeupBreak='0'
EnableEcho='0'
EnableToneDetect='0'
EnableFullPwrTX='0'
EnableBackSpace='0'
EnableGDataToSample='0'
EnableStripHostEcho='0'
EnableBinaryData='1'
SerialType='0'
TermToHost='255'
TermFromHost='255'
SerialBreakLen='50'
MaxNumSamples='40'
GroupNumber='0'
THOST0='0'
THOST1='5'
THOST2='100'
THOST3='12000'
THOST4='100'
THOST5='5'
TMODEM2='500'
TMODEM3='15000'
/>
</ConfigurationData>
```

Note that the serial number and device ID will vary by device.

5.6 Troubleshooting a Built-In Test Failure

The built-in tests check the major DVS modules and signal paths. If a built-in test fails, use the following steps to provide the needed information to the Teledyne RDI Field Service group to help reduce the investigation process (see Technical Support).

5.6.1 Identify the DVS

Prepare a log file (see Using the DVS Software Terminal Screen, and make sure the **Log results to File** box is selected) with the returns from the following commands:

- BREAK
- PS0
- PS3
- PA
- PC20
- PC40
- PT3 (ensure the transducer beams are fully submerged in water prior to performing this test)

NOTE. Always run the PT3 test with unit transducer beams submerged in water. A bucket of water is sufficient but if possible run at least one PT3 at the deployment site.

The returns from these commands will display the unit firmware version, the system operating frequency, beam matrix information, and verify that the electronics are working as expected.

5.6.2 Built-in Tests Failure

If a test failed, repeat the test several times rotating the DVS by 90 degrees each time. By doing so, it may be determined that the failure is directional. Please be sure to log the results to a file. If other magnetic, acoustic, or high current systems are in the vicinity of the DVS, if possible, please power down the equipment and or remove the equipment (at least three meters away) during diagnostic testing; re-run the tests. Modify the log file by adding a note as to what has been done prior to the test such as: ***"Turning 300KHz Sonar off"*** for instance.

5.7 Troubleshooting Data Problems

This section contains the different tasks that should be performed on the site where you experience data quality issue(s).

5.7.1 Provide DVS Set-up

Provide a copy of the *DVS* software deployment file (*.*dvs*) or a log file with the commands sent to the DVS during deployment. Include the following groups of commands:

```
>C?
>E?
>P?
>T?
>W?
```

5.7.2 Describe the Deployment and Environment

Provide a description of the environment where you are deploying; in particular, details on water description (for instance: highly concentrated in sediment waters…). Additionally, provide a description of the intended deployment. Please provide details on environment commands, range expected, standard deviation expected, and goal of the mission.

5.7.3 Provide Raw Data

Recover the raw data from your instrument preferably in PD20 output format and send the complete deployment data together with a description of the issue that you are experiencing and if possible some screenshots or ensemble numbers to locate region(s) showing the unexpected data behavior. If it is not possible to provide PD20 data, please identify the data format in which data was collected.

As previously mentioned in Troubleshooting a Built-In Test Failure, if other devices are in the vicinity of the DVS and are suspected to be the origin of the data quality issue, if possible power the device down or remove it from the area (at least three meters) and re-deploy.

5.8 Technical Support

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

Teledyne RD Instruments

14020 Stowe Drive
Poway, California 92064

Phone +1 (858) 842-2600

FAX +1 (858) 842-2822

Sales – rdisales@teledyne.com

Field Service – rdifs@teledyne.com

Teledyne RD Instruments Europe

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

Phone +33(0) 492-110-930

FAX +33(0) 492-110-931

Sales – rdie@teledyne.com

Field Service – rdiefs@teledyne.com

Client Services Administration – rdicsadmin@teledyne.com
Web: http://www.rdinstruments.com
24 Hour Emergency Support +1 (858) 842-2700

5.9 DVS Cables

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

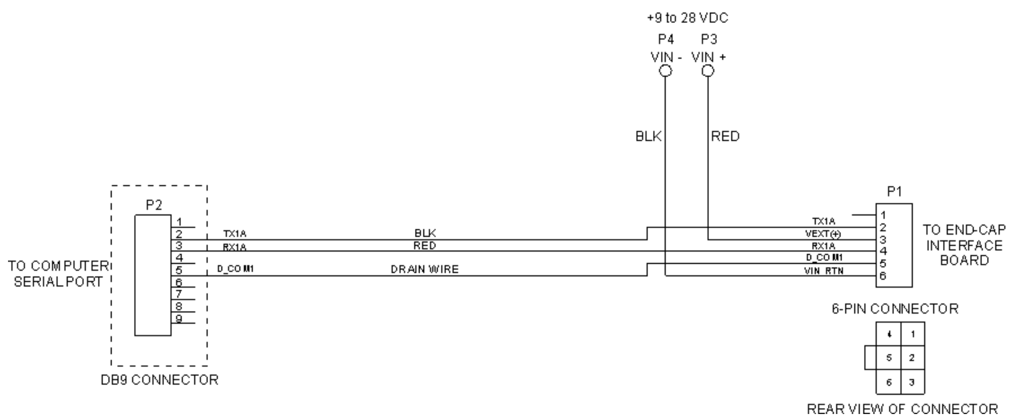


Figure 43. Test Cable Wiring

NOTE. The test cable is only included with systems that have the Inductive Modem Module.

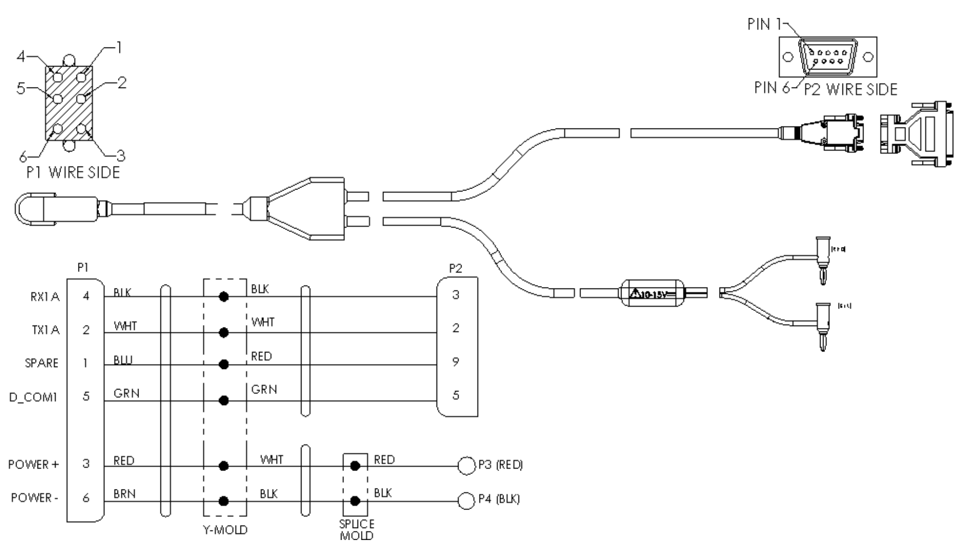


Figure 44. Underwater Cable

NOTE. The underwater cable is only included with systems that have the connector on the end-cap.

5.10 System Overview

This section presents a functional description of DVS operation using block diagrams.

5.10.1 Operating Modes

There are two main operational modes in the DVS: Command mode and Autonomous mode. The command processor is active in both modes; however there are differences in the valid command set within each mode.

Command Mode

Most commands are available in Command mode. The user can change the sampling configuration, run diagnostic tests, initiate polled sample requests, and start the Autonomous mode by sending a CS command.

Autonomous Mode

The commands available in Autonomous mode are limited. In this mode, the DVS samples data at pre-programmed intervals and stores the data in flash memory. The user can retrieve the last recorded ensemble (Combo request), or the average of ensembles for a selected time segment (Averaging request). The user can also perform a polled sampling, display certain configuration values, or switch back to the Command mode by sending a Hard Break.

- **Combo:** The surface inductive modem can request the last sample placed in flash memory at the pre-programmed interval. In addition, the user can command additional samples for immediate download. Any additional samples commanded are done without impacting the ongoing autonomous data collection. In case of a conflict, the pre-programmed measurement takes precedence. When a conflict occurs, the firmware delays the polled sample until the pre-programmed sample has been completed. A message to that effect is output when the command is given.
- **Averaging:** The DVS keeps a running average of all data gathered between requests for the last average. The time period covered by the average is dictated by the time between these requests.
- **Polled:** On command, the DVS can take one or more samples and transmit the data via the integrated inductive modem using Sea-Bird protocols. A time stamp is included with each sample. If a polled sample is requested at a time that would interfere with a pre-programmed sample, the pre-programmed sample has precedence, and the polled request will be rejected. A message to that effect is output when the command is given.

The DVS sleeps between samples if there is enough time, and the alarm in the real-time clock is used to wake the DVS at the proper time to collect a sample. The firmware responds to the alarm while awake, as well as while asleep, because the user may wake the system to request a sample close to the time when a pre-programmed sample is scheduled.

The DVS is designed to allow communication via the IMM without interruption of the preprogrammed sampling. An example sequence of commands (with comments) follows:

forcecaptureline<ctrl-M><ctrl-J>

```
#ID<Ctrl-M><Ctrl-M><Ctrl-J> (wakes up the DVS without interrupting its program)
!IDsendbreak<Ctrl-M><Ctrl-J> (tells the DVS to listen to the IMM)
#IDCO<Ctrl-M><Ctrl-M><Ctrl-J> (commands a polled sample (for example))
#IDCZ<Ctrl-M><Ctrl-M><Ctrl-J> (tells the DVS to go back to sleep)
```

Note “ID” is the identification number of the IMM in the DVS.

5.10.2 Overview of Normal DVS Operation

The following events occur during a typical data collection cycle.

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

The DVS determines what to do based on where the wake-up came from (a Break, CS-command, battery saver timer, or watchdog timer was detected).

Overview of Sample collection

The DVS is based on samples rather than pings. A sample consists of taking as many measurements as is possible from all sensors within one second. The samples are gathered asynchronously.

- The number of velocity samples is configuration dependent.
- For the thermistor, that will be one sample for the TRDI sensor, ~ two samples for the optional Sea-Bird high resolution sensor.

> **NOTE.** The TRDI sensor will always use the temperature from the **last** sample –there is a lag.

- For the compass this will be ~10 samples.

5.10.3 Functional Description of Operation

The following paragraphs describe how the DVS operates and interacts with its modules. The system consists of ten functional blocks.

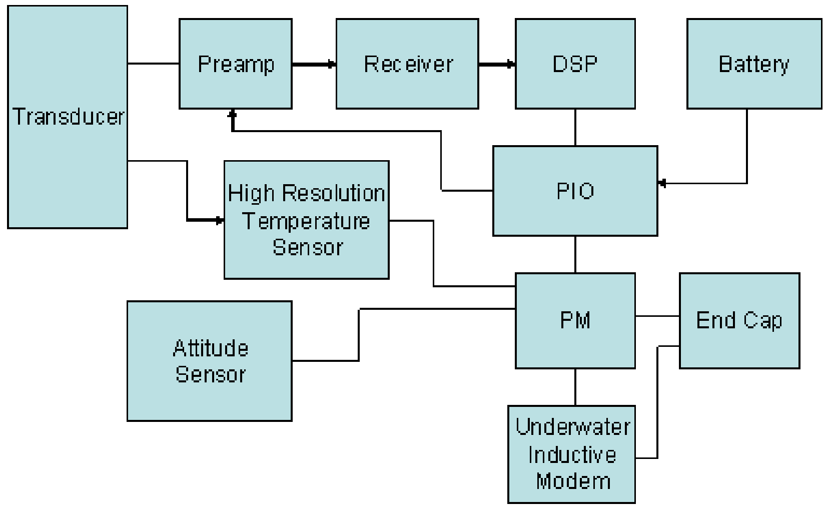


Figure 45. DVS Block Diagram

Transducer:

The Transducer is attached to one end of the housing. The primary function of the transducer is to convert electrical energy to acoustic energy and back again. Four ceramic assemblies, also known as 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. Located in the center of the transducer between the beams is a temperature probe. On the back side of the transducer is an O-Ring seal which mates with the housing.

Preamp:

The Preamp contains low noise amplifiers, transformers, and transmit/receive switches for the four transducer beams. The transducer beams are electrically connected to the preamp transformers. The transformers provide impedance matching and a convenient connection point for the transmit signal. The transformer output is fed to a low noise amplifier whose output is fed to the receiver.

Receiver:

The Receiver contains a high gain amplifier, base band mixer, and a low pass filter (LPF). The analog signals provided by the Preamp, whose center frequency is the system frequency, are mixed in quadrature with a local oscillator to produce two signals called Sine and Cosine. This “complex” signal is then filtered by a Low Pass Filter (LPF) to eliminate unwanted higher frequencies. Finally, the output from the LPF along with a Receiver Signal Strength Indicator (RSSI) signal, are made available to the DSP.

DSP:

The Digital Signal Processor contains both the hard-limit sampler and the 8 bit digitizers which convert the LPF outputs to digital values. The digital data is then processed by the DSP to produce Velocity, Amplitude, and Correlation profile data. The DSP also controls transmitter, serial communication, recorder, and real time clock functions.

PIO:

The Power Input/Output converts and supplies DC voltages to all of the system circuitry. The PIO contains transmit drivers and transformers and a device for monitoring the battery voltage. A connector is also provided as a battery connection point.

Personality Module:

The Personality Module provides a convenient connection point for the OEM modules. It also provides a path for DVS I/O and power to/from the end cap. Serial communications for each OEM device is routed though the PM to the PIO. A DC regulator, under DSP control, provides 9 VDC to the OEM devices.

Inductive Modem Module:

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

High Resolution Temperature Sensor:

The High Resolution Temperature Sensor provides extremely accurate temperature data to the DVS. The DVS uses an OEM version of the Sea-Bird Electronics SBE38 for this function.

Attitude Sensor:

The Attitude Sensor will provide Heading, Pitch, and Roll data to the DVS. The DVS uses the Precision Navigation TCM5 sensor.

Battery:

The battery 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 18VDC.

End Cap:

The End Cap consists of an O-Ring seal, underwater electrical connector or an underwater-inductive-modem mooring-line clamp/interface. External electrical connections through the end cap consist of one full duplex RS232 serial port and a DC input.

6 Returning a DVS to TRDI for Service

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

6.1 USA and Non-European Shipments

Step 1 - Get a Return Material Authorization

The best way to make sure TRDI is aware of your intentions to ship equipment is to obtain a Return Material Authorization (RMA) before sending the shipment. Return Material Authorizations are issued by Sales Administration or Client Services Administration (rdicsadmin@teledyne.com) and are used to notify us of your needs in advance of arrival so we can provide a faster turnaround. When requesting a Return Material Authorization, please give us the following information.

- What is being shipped (include the serial number)
- When you plan to send the shipment
- What problem(s) need correction
- When you need the instrument returned

When the Return Material Authorization is issued, we will tell you the RMA number. Please include this number on all packages and correspondence.

Step 2 - Ship via air freight, prepaid

Urgent Shipments should be shipped direct to TRDI via any of several overnight or priority air services. Do not send urgent airfreight as part of a consolidated shipment. If you ship consolidated, you will save money, but may lose up to three days in transit time.

Non-urgent shipments may be shipped as part of a consolidated cargo shipment to save money. In addition, some truck lines may offer equivalent delivery service at a lower cost, depending on the distance to San Diego.

Mark the Package(s)

To: **Teledyne RD Instruments, Inc. (RMA Number)**
14020 Stowe Drive
Poway, California 92064

Airport of Destination = San Diego
Notify Paxton, Shreve, and Hayes
Phone: +1 (619) 232-8941
Fax: +1 (619) 232-8976

Step 3 - Urgent shipments

Send the following information by fax or telephone to TRDI.

Attention: **Client Services Administration**
Fax: **(858) 842-2822**
Phone: **(858) 842-2600**

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

6.2 European Shipments

Step 1 - Get a Return Material Authorization

The best way to make sure TRDI is aware of your intentions to ship equipment is to obtain a Return Material Authorization (RMA) before sending the shipment. Return Material Authorizations are issued by Sales Administration or Client Services Administration (rdicsadmin@teledyne.com) and are used to notify us of your needs in advance of arrival so we can provide a faster turnaround. When requesting a Return Material Authorization, please give us the following information.

- What is being shipped (include the serial number)
- When you plan to send the shipment
- What problem(s) need correction
- When you need the instrument returned

When the Return Material Authorization is issued, we will tell you the RMA number. Please include this number on all packages and correspondence.

Step 2 - Ship Via Air Freight, Prepaid

Urgent Shipments should be shipped direct. Do not send urgent airfreight as part of a consolidated shipment. If you ship consolidated, you will save money, but may lose up to five days in transit time.

Non-urgent shipments may be shipped as part of a consolidated cargo shipment to save money.

Mark the package(s) as follows:

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

Step 3 - Include Proper Customs Documentation

The Customs statement should be completed very carefully. It should accurately and truthfully contain the following information.

- Contents of the shipment
- Value
- Purpose of shipment (example: "American made goods returned for repair")
- Any discrepancy or inaccuracy in the Customs statement could cause the shipment to be delayed in Customs.

Step 4 - Send the Following Information by Fax or Telephone to TRDI Europe

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

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

7 Introduction to Commands

This guide defines the commands used by the DVS. These commands (Table 14) let you set up and control the DVS without using an external software program such as our *DVS* program. However, we recommend you use our software to control the DVS because entering commands directly from a terminal can be difficult. *Make sure you read and understand Using Direct Commands to Deploy your DVS before deploying your DVS.* Most DVS settings use factory-set values (Table 15). If you change these values without thought, you could ruin your deployment. *Be sure you know what effect each command has before using it.* Call TRDI if you do not understand the function of any command.

Using the *DVS* software to develop the command file will ensure that the DVS is set up correctly. The commands shown in Table 14 directly affect the range of the DVS, the standard deviation (accuracy) of the data, and battery usage.

> **NOTE.** This guide applies to DVS firmware version 43.xx.
>
> When new firmware versions are released, some commands may be modified, added, or removed. Read the README file on the upgrade disk. When an addition or correction to this manual is needed, an Interim Change Notice (ICN) will be posted to our web site. Please check our TRDI's web site often at www.rdinstrument.com.

7.1 Data Communication and Command Format

You can enter commands with an IBM-compatible computer running *DVS*. The DVS communicates with the computer through an RS-232 serial interface or Inductive Modem. We initially set the DVS at the factory to communicate at 9600 baud, no parity, and one stop bit.

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

```
[Break Wakeup A]
DVS 43.xx
RD Instruments (c) 1996-2006
All rights reserved.
>
```

7.1.1 Command Input Processing

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

```
>WP100<CR> [Your input]
```

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

```
>WP100<CR>     [Your original input]
>              [DVS response to a valid, no-output command]
```

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

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

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

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

7.1.2 Data Output Processing

The DVS collects samples. One sample consists of as many pings as the DVS can make in one second, and this number will depend on the exact setup. The WP command is used to set the number of samples that are included in an ensemble. Note that the DVS allows users to configure the number of samples in an ensemble, but not the number of pings in a sample. Experienced users of TRDI products should note that the WP command means something different for the DVS than it does for other TRDI products. The TP command is used to set the time between samples within an ensemble. In the data output, however, the actual number of pings that were used in the sample is recorded in the ensemble binary data. For example, to collect five samples in the ensemble, and each sample has 30 pings, then send WP5 as the WP command, but the data output will record that 150 pings were in the ensemble. Experienced TRDI users should note that the actual number of pings is stored in the data output file rather then the setting of the WP command. Recording the actual number of pings is as done with other TRDI products.

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

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

CR0 it will load into RAM the command set you last stored in non-volatile memory (semi-permanent user settings) through the CK-command. If the DVS receives a CR1, it will load into RAM the factory default command set stored in ROM (permanent or factory settings).

7.2 Firmware Updates

The firmware for DVS units is located on flash RAM chips on the DSP board. Use the following procedure to install the firmware update in the DVS.

a. Connect your DVS to the computer as shown in Test Setup – Inductive Modem even if the DVS has an end-cap with connector.

b. Start the program *DVSxxFW.exe* (where *xx* is the firmware number).

c. Click **Setup**. Click the **View README.TXT** button to view the Read-me.txt file for details on what is new in this version of the firmware.

d. Click **Next** and follow the on-screen prompts.

e. If you are not able to install the new firmware, contact Customer Service (see Technical Support).

f. After successfully upgrading the firmware, Use the DVS software to test the DVS (see Testing the DVS).

> **CAUTION.** It may take up to five minutes for the firmware to finish the upgrade once it reports 99% complete. **Do NOT remove DVS power during this time.** If power is removed before the DVS firmware is completely uploaded, the DVS will not function and must be returned to TRDI for repair.

7.3 Using Direct Commands to Deploy your DVS

TRDI recommends that you use our *DVS* software program as your primary method of deployment. If this is not possible in your deployment then we ***strongly recommend*** that the commands shown in Table 13 be the ***minimum*** commands you send to the instrument.

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

Table 13: DVS Minimum Required Commands for Deployments

Command	Description
CR1	This command will set your DVS to a known factory default setting and **must be your first command**
CFxxxxx	This command will set your DVS collection mode; binary, etc.
ESxx	This command will set the salinity of the water
EAxxxxx	This command will set your magnetic compass offset for true north
EDxxx	This command will set your DVS depth
ESxx	This command will set your DVS's expected salinity
EXxxxxx	This command will set your DVS's coordinate system; earth, beam, etc.
EZxxxxxxx	This command will set what sensors will be used by your DVS; heading, pitch, roll, temp, etc.
WNxx	This command will set the number of depth cells to collect
WPxx	This command will set the number of samples to average
WSxxxx	This command will set the depth cell size to use
TExxxxxxxx	This command will set the time between ensembles
TPxxxxxx	This command will set the time between samples
CK	This command will save your setup to the internal RAM and **must be your second to last command**
CS	This command will start your deployment and **must be your last command**

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

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

The following example command file would set the DVS to automatic binary pings, salinity set to 35 (salt-water), transducer depth set to 10 meters, magnetic variation set to 12.5 degrees, blanking set to 30 centimeters, maximum range of 2.5 meters (5 x 0.5 meter cells), and takes one sample every 10 minutes.

```
CR1
CF11100
ES35
ED0100
EB1250
TE00100000
WP1
WN5
WS50
TP100000
WF03
CK
CS
```

7.4 Command Summary

Table 14 gives a summary of the DVS input commands, their format, and a brief description of the parameters they control. Table 15 lists the factory default command settings.

NOTE. Not all commands can be sent via the inductive modem.

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

Table 14: DVS Input Command Summary

Command	Description
?	Shows command menu (deploy or system)
<BREAK> End	Break - Interrupts or wakes up DVS and loads last settings used
+++ or ===	Soft Break
Y	Display banner
CA	Communication Timeout
CB*nnn*	Serial port control (baud rate/parity/stop bits)
CF*nnnn*	Flow control
CK	Keep parameters as user defaults
CL	Sleep Enable
CO	Collect and Output A Sample
CR*n*	Retrieve parameters (0 = User, 1 = Factory)
CS	Start pinging
CT	Turnkey
CV	Output Average Ensemble
CW	Output the Last Stored Ensemble
CZ	Put the DVS to Sleep
EA±*nnnn*	Heading alignment (-179.99 to 180.00 degrees)
EB±*nnnn*	Heading bias (-179.99 to 180.00 degrees)
EC*nnnn*	Speed of Sound (1400 to 1600 m/s)
ED*nnnn*	Transducer Depth (0 to 65535 dm)
EH*nnnn*	Heading (000.00 to 359.99 degrees)
EP±*nnnn*	Pitch (-60.00 to +60.00 degrees)
ER±*nnnn*	Roll (-60.00 to +60.00 degrees)
ES*nn*	Salinity (0 to 40)
ET±*nnnn*	Water Temperature (-5.00 to +45.00 degrees C)
EX*nnnn*	Coordinate Transformation (Xform:Type; Tilts; 3Bm; Map)
EZ*nnnnnn*	Sensor Source (C;D;H;P;R;S;T)
ME	ErAsE recorder
MM	Show Memory Usage
MN	Set Deployment Name
MQ	Streaming Download
MR	Set Recorder On/Off
MY	Y-Modem Download
PA	Run Go/No-Go Tests
PC0	Built In Tests
PC2	Display Sensor Data
PC4	Display Voltage Monitor ADC Data
PC20	Display Scrolling Sensor Data
PC40	Display Scrolling Voltage Monitor Data

Continued Next Page

Table 14: DVS Input Command Summary (continued)

Command	Description
PD	Data Stream Select
PF	Results from most recent PA tests
PS0	Display System Configuration
PS3	Display Instrument Transformation Matrix
PT3	Built-In test
SC	Compass Calibration
SG nPts StabChk	Configure Compass Calibration (nPts [1-50] StabChk [1,0])
TEhh:mm:ss.ff	Time Between Ensembles
TFyy/mm/dd, hh:mm:ss	Set First Ping Time (year/month/day, hours:minutes:seconds)
TPmm:ss.ff	Time Between Samples
TSyy/mm/dd, hh:mm:ss	Set System Date and Time (year/month/day, hours:minutes:seconds)
WD vca ps* ***	Data Out {v;c;a;p;s;*;*;*;*}
WF*nnnn*	Blanking Distance (0 to 9999 cm)
W*Nn*	Number of Bins [1-5]
WP*nnn*	Number of Samples
WS*nnnn*	Bin Size

Table 15: DVS Factory Defaults

Command	Default
CB	811
CF	11110
CL	1
CT	1
EA	+00000
EB	+00000
EC	1500
ED	00000
EH	00000
EP	+0000
ER	+0000
ES	35
ET	2100
EX	11111
EZ	1022202 (Sea-Bird) 1022201 (TRDI)
MN	DVS
PD	20
TE	00100000
TP	00100000
WD	111100000
WF	100
WN	5
WP	1
WS	100

8 Command Descriptions

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

Break

Purpose	Wakes up the DVS so it can accept commands.
Format	BRK

Recommended Setting. Use as needed.

Description: If the Break is issued over the RS-232 port, the DVS is reset and any deployment in progress is stopped. The command port is set to the RS-232 port.

If the Break is issued over the inductive modem interface, the DVS switches the command port to the modem port. No reset is generated, and any deployment in progress is not disturbed.

NOTE. Any character received (on either of the RS-232 or the modem ports) while the DVS is asleep will cause the DVS to wake up, however that character will not be processed as part of any command and will not interrupt the deployment.

Soft Break

Purpose	Resets the DVS.
Format	SBRK
Range	+++ or ===
Description	Resets the DVS, and stops any deployment in progress. Sending a soft break sets the command port to the RS-232 port.

NOTE. When communicating with the DVS over the inductive modem interface, a Soft Break must be followed by a hard break (using the modem's SendBreak command) to set the command port to the modem port.

Banner

Purpose Displays the DVS banner.

Format Y

Recommended Setting. Use as needed.

Description Displays the DVS banner, with firmware version information.

8.1 Control System Commands

The DVS uses the following commands to control certain system parameters.

8.1.1 Available Control System Commands

This section lists the Control System commands.

```
>c?
Available Commands:

CA 0 -------------------- Communication Timeout (0=Off,10-65536 sec)
CB 811 ------------------ Serial Port Control {baud;parity;stop}
CF 11110 ---------------- Set Ctrl Flags {e;p;b;s;*}
CK ---------------------- Save Command Parameters to Flash
CL 1 -------------------- Sleep Enable ( 1=Enabled, 0=Disabled )
CO ---------------------- Collect and Output A Sample
CR ---------------------- Restore Cmd defaults [0=user,1=factory]
CS ---------------------- Start Pinging
CT 0 -------------------- Turnkey (0 = OFF, 1 = ON)
CV ---------------------- Output Average Ensemble
CW ---------------------- Output the Last Stored Ensemble
CZ ---------------------- Put the ADCP to sleep.
C? ---------------------- Display C-Command Menu
```

8.1.2 Control System Command Descriptions

CA – Communication Timeout

Purpose	Sets the timeout period for the activity timer.
Format	CA*nnnnn*
Range	*nnnnn* = 0 (off), 10 to 65536 seconds
Default	CA120

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

Description	The CA command sets the activity timeout period, in seconds. The activity timer is reset when a valid command is received. If no valid command is received within the timeout period, the DVS will either go to sleep, or deploy itself, depending on the setting of the CT (Turnkey) command. If Turnkey mode is enabled (CT1) then the DVS will self-deploy after the activity timeout period has elapsed.

CB - Serial Port Control

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

Default CB811

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

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

Table 16: Serial Port Control

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

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

a. Connect and power up the DVS unit as shown in Figure 37 or Figure 38.

b. Start the *DVS* program and begin a terminal session with the DVS (see Using the DVS Software Terminal Screen).

c. Send the command `CR1` to place the DVS in the factory default setup.

d. Send the CB-command that selects the baud rate you wish. The following are the typical CB-command settings for different baud rates with no parity and 1 stop bit:

Table 17: Baud Rate

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

e. Send the command CK to save the new baud rate setting.

f. Click **OK** to exit the terminal window.

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

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

CF - Flow Control

Purpose	Sets various DVS data flow-control parameters.
Format	CF*nnnnn*
Range	Firmware switches (see description)
Default	CF11100

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

Description — The CF-command defines whether the DVS: generates data ensembles automatically or manually; generates pings immediately or manually; sends serial output data in binary or Hex-ASCII format; sends or does not send output data to the serial interface.

Table 18: Flow Control

Command	Description
CF1xxxx	Automatic Ensemble Cycling – Automatically starts the next data collection cycle after the current cycle is completed. Only a <BREAK> can stop this cycling.
CF0xxxx	Manual Ensemble Cycling – **Manual ensemble not currently available.**
CFx1xxx	Automatic Ping Cycling – Pings immediately when ready.
CFx0xxx	Manual Ping Cycling – **Manual ping cycling not currently available.**
CFxx1xx	Binary Data Output – Sends the ensemble in binary format, if serial output is enabled (see below).
CFxx0xx	Hex-ASCII Data Output – Sends the ensemble in readable hexadecimal-ASCII format, if serial output is enabled (see below).
CFxxx1x	Enable Serial Output – Sends the data ensemble out the RS-232 serial interface.
CFxxx0x	Disable Serial Output – No ensemble data are sent out the RS-232 interface.
CFxxxx0	Reserved

CK - Keep Parameters

Purpose Stores present parameters to non-volatile memory.

Format CK

Recommended Setting. Use as needed.

Description CK saves the present user command parameters to non-volatile memory on the DSP board. The DVS maintains data stored in the non-volatile memory (user settings) even if power is lost. It does not need a battery. You can recall parameters stored in non-volatile memory with the CR0-command.

CL – Sleep Enable

Purpose Determines whether the DVS will attempt to conserve power by sleeping between samples.

CAUTION. Setting this command to zero while on battery power will quickly deplete the batteries!

Format CL*n*

Range *n* = 0 to 1 (0 = Sleep Disabled, 1 = Sleep Enabled)

Default CL1

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

Description Setting the CL command to CL1 enables the DVS to sleep between samples if there is enough time. If the CL command is set to CL0, the DVS will not try to sleep between samples.

CO – Collect and Output A Sample

Purpose Tells the DVS to collect a sample and transmit the data in PD20 format. Note: these samples are not stored in the DVS memory!

Format CO

Recommended Setting. Use the DVS software - Data Recovery.

Description This command will cause the DVS to collect a sample and transmit the data via the inductive modem. Each sample contains a time stamp. This command is valid only during a deployment for PD0 or PD20 output formats, and follows the CF command setting for binary or Hex-ASCII output. The ensemble number will be zero, and the ensemble can be identified by the time stamp. An error message will be given if this command is issued too close to the next scheduled ping time (within 2 seconds).

NOTE. When using this command 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.

CR – Restore Command Defaults

Purpose Resets the DVS command set to factory or user settings.

Format CR*n*

Range *n* = 0 (User), 1 (Factory)

Recommended Setting. Use as needed.

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

Table 19: Retrieve Parameters

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

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

CS – Start Pinging

Purpose Starts the data collection cycle.

Format CS

Recommended Setting. Use as needed. Use the DVS software to create the command file. The CS command will be added to the end of the command file and sent to the DVS by the software.

Description Use CS to tell the DVS to start sampling in autonomous mode according to the profiling configuration parameters (i.e. W-commands). Output and recording of the data are governed by the T and M command menus. The command **CStop** stops autonomous data collection.

> **NOTE.** After a CS command is sent to the DVS, no changes to the command can occur until a <BREAK> is sent or the command CStop is issued.

CState – Status

Purpose	Displays the status of the DVS.
Format	CState

> **Recommended Setting.** Use as needed.

Description	Displays either “Pinging” or “Not Pinging”, depending on the state of the DVS.

CStop – Stop Pinging

Purpose	Stops the current deployment.
Format	CStop

> **Recommended Setting.** Use as needed.

Description	Stops autonomous sampling.

CT – Turnkey Mode

Purpose	Sets Turnkey mode.
Format	CTx
Range	x = 1 (on), 0 (off)
Default	CT1

> **Recommended Setting.** Use as needed.

Description	If the Turnkey mode is enabled, the DVS will self-deploy (i.e. start pinging) within 10 seconds after a break unless a valid command is received within that time. After that, the DVS will self-deploy when the activity timer (set by the CA command) period expires.

CV – Output Average Ensemble

Purpose Requests the average of all samples collected since the last CV polled request.

Format CV

> **Recommended Setting.** Use the DVS software - Data Recovery.

Description This command requests the average of all samples collected since the last CV polled request. This command is valid only during a deployment, and when PD20 format is being used and follows the CF command setting for binary or Hex-ASCII output. This command will give an error message until valid data is available.

> **NOTE.** When using this command 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.

CW – Output the Last Stored Ensemble

Purpose Requests the most recently stored ensemble for output.

Format CW

> **Recommended Setting.** Use the DVS software - Data Recovery.

Description Recalls the most recently stored ensemble for output. This command is only valid during a deployment, and will give an error message until valid data is available. The CW command is available for PD0 or PD20 output formats, and follows the CF command setting for binary or Hex-ASCII output.

> **NOTE.** When using this command 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.

CZ – Put DVS to Sleep

Purpose Tells the DVS to power down.

Format CZ

Recommended Setting. This command should be used whenever batteries have been installed and you do not send commands to start a deployment.

Description Sending the CZ-command powers down the DVS. DVS processing is interrupted and the DVS goes in the STANDBY mode (RAM is maintained). A five-second delay before sleep will occur if the command is given over the inductive modem interface.

NOTE. By default, the activity timer set by the CA command is ON (see CA – Communication Timeout) and the CT command is ON (see CT – Turnkey Mode). This means that the DVS will start pinging after 120 seconds if no command is sent.

CAUTION. If you do not use the CZ-command, the DVS will deploy with whatever commands are presently set. If you leave the DVS running a sensor test under battery power, a *new battery will be discharged in a few days*.

8.2 Environmental Commands

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

8.2.1 Available Environmental Commands

This section lists the available Environmental commands.

```
>e?
Available Commands:

EA +00000 --------------- Heading Alignment (0.01 deg)
EB +00000 --------------- Heading Bias (0.01 deg)
EC 1500 ----------------- Speed Of Sound (m/s)
ED 00000 ---------------- Xdcr Depth (deci-meters)
EH 00000 ---------------- Heading (0..35999; 1/100 degrees)
EP +00000 --------------- Pitch (+-7000 1/100 degrees)
ER +00000 --------------- Roll  (+-7000 1/100 degrees
ES 35 ------------------- Salinity (ppt)
ET 2100 ----------------- Water Temperature (.01 deg C)
EX 11111 ---------------- Coordinate Transformations (cct3m)
EZ 1022202 -------------- Sensor Source {c;d;h;p;r;s;t}
E? ---------------------- Display E-Command Menu
```

8.2.2 Environmental Command Descriptions

EA – Heading Alignment

Purpose	Corrects for physical misalignment between Beam 3 and the heading reference.
Format	EA±*nnnnn*
Range	±*nnnnn* = -17999 to 18000 (-179.99 to 180.00 degrees)
Default	EA00000

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

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

EB - Heading Bias

Purpose	Corrects for electrical/magnetic bias between the DVS heading value and the heading reference.
Format	EB±*nnnnn*
Range	±*nnnnn* = -17999 to 18000 (-179.99 to 180.00 degrees)
Default	EB00000

Recommended Setting. Use EB to counteract the effects of magnetic declination at the deployment site. Set using the DVS Software.

Description — EB is the heading angle that counteracts the electrical bias or magnetic declination between the DVS and the heading source. Use the EA-command to correct for physical heading misalignment between the DVS and a vessel's centerline.

Example — A DVS is receiving heading from its internal compass. A navigation map for the deployment area shows a declination of 10°10′W 1995 (9′E/year). This means the magnetic offset in the year 2001 at this location is (- (10+10/60) + (9/60*6)) = -9.26666 degrees. Set the EB command value to EB-00926.

EC - Speed of Sound

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

Format — EC*nnnn*

Range — *nnnn* = 1400 to 1600 meters per second

Default — EC1500

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

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

NOTE. The EC command is not used if the EZ command is set to calculate speed of sound based on temperature, salinity, and transducer depth.

ED - Depth of Transducer

Purpose — Sets the DVS transducer depth.

Format — ED*nnnnn*

Range — *nnnnn* = 0 to 65535 deci-meters (meters x 10)

Default — ED00000

Recommended Setting. Use the EZ-command (Set using the DVS Software.).

Description — ED sets the DVS transducer depth. This measurement is taken from sea level to the transducer faces. The DVS uses ED in its speed of sound calculations and to determine depth cell ranges relative to the water surface. The DVS assumes the speed of sound reading is taken at the transducer head. See the primer for information on speed of sound calculations.

NOTE. The ED command is not used if the EZ command is set to calculate speed of sound based on temperature, salinity, and transducer depth.

EH - Heading

Purpose	Sets the DVS heading angle.
Format	EH*nnnnn*
Range	*nnnnn* = 0 to 35999 (000.00 to 359.99 degrees)
Default	EH00000

Recommended Setting. Use the EZ-command.

Description Sets the fixed heading to use if the EZ command is set to use a fixed heading.

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

EP - Pitch (Tilt 1)

Purpose	Sets the DVS pitch (tilt 1) angle.
Format	EP±*nnnn*
Range	±*nnnn* = -7000 to 7000 (-70.00 to +70.00 degrees)

Recommended Setting. Use the EZ-command.

Description EP sets the DVS pitch (tilt 1) angle.

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

```
EP = 14.00 × 100 = 1400 = EP01400 (+ is understood)
EP = -3.50 × 100 = -350 = EP-00350
```

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

ER - Roll (Tilt 2)

Purpose Sets the DVS roll (tilt 2) angle.

Format ER±*nnnn*

Range ±*nnnn* = -7000 to 7000 (-70.00 to +70.00 degrees)

Recommended Setting. Use the EZ-command.

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

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

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

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

ES – Salinity

Purpose Sets the water's salinity value.

Format ES*nn*

Range *nn* = 0 to 45 parts per thousand

Default ES35

Recommended Setting. Set using the *DVS* software. The default setting for this command is recommended for most applications.

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

ET - Temperature

Purpose Sets the water's temperature value.

Format ET±*nnnn*

Range ±*nnnn* = -500 to 4500 (-5.00 C to +45.00 C)

Default ET2100

Recommended Setting. Use the EZ-command.

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

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

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

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

EX – Coordinate Transformation

Purpose — Sets the coordinate transformation processing flags.

Format — EX*xxptb*

Range — *xx* = Transformation
p = Pitch and Roll
t = 3 beam solutions
b = Bin mapping

Default — EX11111

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

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

Table 20: Coordinate Transformation Processing Flags

Setting	Description
EX00xxx	No transformation. Radial beam coordinates, I.E., 1, 2, 3, 4. Heading/Pitch/Roll not applied.
EX01xxx	Instrument coordinates. X, Y, Z vectors relative to the DVS. Heading/Pitch/Roll not applied.
EX10xxx	Ship coordinates (Note 1). X, Y, Z vectors relative to the ship. Heading not applied. EA-command used, but not the EB-command. If Bit 3 of the EX-command is a 1, then Pitch/Roll applied.
EX11xxx	Earth coordinates (Note 1) East, North, Vertical vectors relative to Earth. Heading applied. EA and EB-commands used. If Bit 3 of the EX-command is a 1, then Pitch/Roll applied.
EXxx1xx	Use tilts (pitch and roll) in transformation (Note 2)
EXxxx1x	Allows 3-beam solutions if one beam is below the correlation threshold
EXxxxx1	Allow bin mapping (see Note 4, next page)

NOTES.

1. For ship and earth-coordinate transformations to work properly, you must set the Heading Alignment (EA) and Heading Bias (EB) correctly. You also must ensure that the tilt and heading sensors are active (EZ).

2. Setting EX bit 3 (Use Tilts) to 0 lets you collect tilt data without using it in the ship or earth-coordinate transformations.

3. Each DVS uses its own beam calibration matrix to correct data for beam pointing errors (e.g., if the beams erroneously point toward 21 degrees instead of 20 degrees). Correction is applied when the data are converted from beam coordinates to earth coordinates. If you output beam-coordinate data, you will need to apply the beam corrections yourself if you want the best possible data.

4. TRDI outputs the Bin 1 position for a level system only. We do not adjust the bin 1 position, or the cell sizes, for any tilt. Bin mapping attempts to combine data from sections of the beams that are at the same depth in the water, and does not make any attempt to calculate how that depth that depth might change for a tilted system. The setting of the EX command has no effect on the reported bin 1 distance or the cell size.

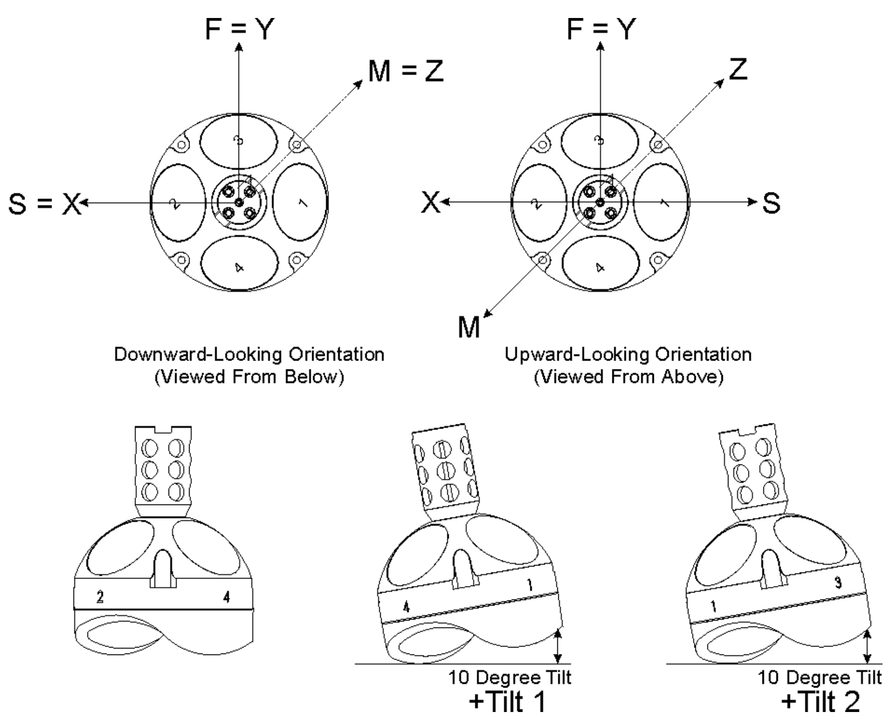


Figure 46. DVS Coordinate Transformation

Sign of Angle for a Unit Facing	Up	Down
Tilt 1 (Pitch) Beam 3 higher than Beam 4	+	+
Tilt 2 (Roll) Beam 2 higher than Beam 1	+	-

EZ - Sensor Source

Purpose Selects the source of environmental sensor data.

Format EZ*cdhprst*

Default EZ1022202 (for DVS units with Sea-Bird temperature sensor)
EZ1022201 (for DVS units with TRDI temperature sensor)

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

Range Firmware switches (see description)

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

Table 21: Sensor Source Switch Settings

	Field	Value = 0	Value = 1	Value = 2
c	Speed Of Sound	Manual EC	Calculate using ED, ES, and ET	N/A
d	Depth	Manual ED	N/A	N/A
h	Heading	Manual EH	Internal TRDI Sensor	Use TCM5 compass
p	Pitch (Tilt 1)	Manual EP	Internal TRDI Sensor	Use TCM5 compass
r	Roll (Tilt 2)	Manual ER	Internal TRDI Sensor	Use TCM5 compass
s	Salinity	Manual ES	N/A	N/A
t	Temperature	Manual ET	TRDI Temperature Sensor	Use SBE38 temperature sensor

Example EZ1022202 means calculate speed of sound from readings, use TCM5 heading, pitch, roll sensors, and the Sea-Bird SBE38 High Resolution Temperature sensor.

NOTE. The value “2” for the EZ flags means to use a “3rd party” sensor, whether internal or external.

8.3 Recorder Commands

The following paragraphs list all the DVS recorder commands. The internal data recorder is capable of storing a minimum of 95,000 samples over a one year deployment. The data recorder contains 16 Mbytes of flash memory, and will stop recording when full, preserving all data collected. Use the *DVS* software to download data from the recorder to a host computer.

8.3.1 Available Recorder Commands

This section lists the available Recorder commands.

```
>m?
Available Commands:

ME ---------------------- ErAsE recorder
MM ---------------------- Show memory usage
MN DVS ------------------ Set deployment name [1..6 characters]
MR 1 -------------------- Set recorder on/off [0=off,1=on]
MQ ---------------------- Streaming Download (addr, nbytes)
MY ---------------------- Y-Modem Download
M? ---------------------- Display M-Command Menu
```

8.3.2 Recorder Command Descriptions

ME – Erase Recorder

Purpose Erase the contents of the recorder.

Format ME ErAsE

Recommended Setting. Use the *DVS* software to erase the recorder (see the DVS Software User's Guide for instructions).

Description The command ME ErAsE erases the recorder memory. To make it more difficult to accidentally erase the data, the word "erase" must be typed with exactly one space after the "ME" (which is not case sensitive) and with alternating upper and lower case letters, as shown.

```
>ME ErAsE
[ERASING...]
```

CAUTION. Once erased, data is not recoverable.

MM – Show Memory Usage

Purpose Shows recorder memory usage.

Format MM

Recommended Setting. Use the DVS software to check the recorder usage (see the DVS Software User's Guide for instructions).

Description Shows memory usage and the number of used and free pages.

```
MM  Loop Recorder pages: used = 0, free = 4096, bytes/page = 528
>
```

MN – Set File Name

Purpose Sets the file name for the recorder.

Format MN *xxx*

Range *xxx* = file name up to six characters, digits, or "_".

Default DVS

Recommended Setting. Use as needed.

Description Sets the deployment name to be used for generating a file name when the data is downloaded. The deployment name can be up to six characters long, and may contain letters, numbers, or the underscore (i.e. "_") character. If no deployment name is specified, a default of "DVS" is used. The deployment name is used as part of the file name for data files when downloaded to the computer using *DVS* (see the DVS Software User's Guide for instructions).

MQ – Streaming Download

Purpose Downloads the recorder.

Format MQ (StartAddr, nbytes)

Range StartAddr: 0 to FFFFFE (Hex)
nBytes: 1 to 16777216 (decimal)

Default N/A

Recommended Setting. Use the DVS software to recover data (see the DVS Software User's Guide for instructions).

Description Downloads the recorder in a streaming fashion, without any special communications protocol.

NOTE. The sum of StartAddr and nBytes must not exceed the available data on the recorder, or the command will be rejected.

MR – Set Recorder On/Off

Purpose Turns the recorder on or off.

Format MR*n*

Range *n* = 0, turn recorder off; *n* = 1, turn recorder on

Default MR1

> **Recommended Setting.** Use as needed.

Description Use the MR command to turn the recorder on/off.

MY – Y-Modem Download

Purpose Downloads the recorder using the Y-Modem protocol. Data is organized for transmission in 1k-byte packets with CRC.

Format MY

> **Recommended Setting.** Use the *DVS* software to recover data (see the DVS Software User's Guide for instructions).

Description Use the MY command to recover data from the recorder only when *DVS* is not available to recover the data.

MY uploads the entire contents of the recorder via the serial interface to a host computer using the standard YMODEM protocol for binary file transfer. Any communications program that uses the YMODEM protocol may be used to upload the recorder data. The data is transferred to the host and stored as DOS files.

> **NOTE.** You must disable the activity timer by sending "CA 0", and disable the Turnkey mode by sending "CT 0" before downloading the recorder. Otherwise, the download will be interrupted at the end of the activity timeout period.

8.4 Performance and Testing Commands

The DVS uses the following commands for calibration and testing.

8.4.1 Available Performance and Testing Commands

This section lists the available Performance and Testing commands.

```
>p?
Available Commands:

PA ---------------------- Run Go/No-Go Tests
PC ---------------------- Built In Tests [0=help]
PD 20 ------------------- Data Stream Select
PS ---------------------- System Info [0=config,3=xform]
PT ---------------------- Built-in-Test Commands; PT0=Help
PF ---------------------- Results from most recent PA tests
P? ---------------------- Display P-Command Menu
```

8.4.2 Performance and Testing Command Descriptions

PA – Run Go/No-Go Tests

Purpose Sends/displays results of a series of DVS system diagnostic tests.

Format PA

Recommended Setting. Use as needed.

Description These diagnostic tests check the major DVS modules and signal paths. We recommend you run this command before a deployment. Each test is listed as PASS or FAIL, and there is a GO/NO-GO summary at the end. This test takes approximately ten minutes to run, during which time other commands will be rejected. The output goes to the RS-232 port, not the modem. Use the PF command over the modem to get the results (see PF – Display PA Results).

The Recorder test takes a long time. At first you will see: *Recorder test...........n*, where n are the numbers changing from 0 to 127 twice and at the end PASS will be displayed if the test is successful.

NOTE. Erase the recorder before running the PA command (see ME – Erase Recorder).

Example

```
>pa
>
RAM test................PASS
ROM test................PASS
RTC test................PASS
UART test...............PASS
```

```
Compass test............PASS
Temperature test........PASS
Recorder test...........PASS
GO

>
```

PC – Built In Tests

Purpose Displays diagnostic information.

Format PCx

Range x = 0, 2, 4, 20, 40

Default N/A

Recommended Setting. Use as needed.

Description See individual command descriptions below.

PC0 – Help

The PC0 command lists the available PC commands, which display data from sensors and ADCs.

PC2 – Display Sensor Data

If using the RS-232 port, samples and displays sensor data in a loop. Outputs <CR> without <LF> at the end of each line to overwrite the same line on the terminal display.

If using the modem port, samples and displays sensor data one time only.

PC4 – Display Voltage Monitor ADC Data

If using the RS-232 port, samples and displays voltage and current data in a loop. Uses <CR> without <LF> at the end of each line to overwrite the same line on the terminal display.

If using the modem port, samples and displays voltage and current data one time only.

PC20 – Display Scrolling Sensor Data

Samples and displays sensor data in a loop similar to the PC2 command, but when used over the RS-232 port it outputs both <CR> and <LF> codes at the end of the line to scroll the display instead of overwriting the same line.

```
Sensor data is sampled and displayed in a loop.
An asterisk '*' to the right of a number indicates invalid data.
Press any key to exit the loop.

Count  Temp(C)  Heading    Pitch     Roll     Depth(m)   Batt(V)    Batt(A)
   0     24.546        0.00    -1.06   -179.97      1.084    11.235      0.072
   0     24.546        0.00    -1.06   -179.97      1.084    11.222      0.079
   0     24.546        0.00    -1.04   -179.97      1.084    11.222      0.073
   0     24.546        0.00    -1.04   -179.97      1.084    11.201      0.090
   0     24.546        0.00    -1.04   -179.97      1.084    11.208      0.075
   0     24.546        0.00    -1.04   -179.97      1.084    11.195      0.074
```

```
>
```

PC40 – Display Scrolling Voltage Monitor Data

Samples and displays voltage and current data in a loop similar to the PC4 command, but when used over the RS-232 port it outputs both <CR> and <LF> codes at the end of the line to scroll the display instead of overwriting the same line.

```
pc40
Battery ADC data is sampled and displayed in a loop.
Press any key to exit the loop.

Count  Chan0  Chan1  Chan2  Chan3    Batt(V)   Batt(A)  VDD1     VDD3
   0    0683   0072   0d3a   0b7b    11.195    0.070    3.314    1.794
   0    0680   008c   0d3a   0b7b    11.175    0.085    3.314    1.794
   0    0688   0066   0d3a   0b7a    11.228    0.062    3.314    1.794
   0    0688   0085   0d3a   0b7a    11.228    0.081    3.314    1.794
   0    0687   007c   0d3a   0b7a    11.222    0.076    3.314    1.794
>
```

PD – Data Stream Select

Purpose Selects the type of ensemble output data structure.

Format PDx

Range x = 0, 20

Default PD20

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

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

Table 22: Data Stream Selections

Format	Description
PD0	Output TRDI standard binary data
PD20	Output DVS format data

PF – Display PA Results

Purpose Displays the most recent PA test results.

Format PF

Range N/A

Default N/A

Recommended Setting. Use as needed.

Description Displays the most recent PA test results. This allows the results to be obtained over the modem interface, which cannot display the PA results directly, because the tests take longer than the modem timeout period.

PS – Display System Parameters

Purpose The PS command sends/displays the DVS system configuration data.

Format PS*n*

Range *n* = 0, 3 (see description)

Recommended Setting. Use as needed.

Description See below.

PS0 – System Configuration

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

```
>PS0
   Serial Number:  0
       Frequency:  2457600 Hz
 Transducer Type:  PISTON
      Beam Angle:  45 Degrees
    Beam Pattern:  CONVEX
         Sensors:
             Temperature:           SeaBird SBE-38
             Heading/Pitch/Roll:    NONE


    CPU Firmware:  41.04d PM0a
    FPGA Version:  5.00.001 [0x5001]
Board Serial Number Data:
 06 00 00 00 52 21 74 23   DSP72B-2232-00X
 C3 00 00 00 35 13 3C 23
 8A 00 00 00 3C F3 3C 23   PER72B-2234-00X
 FA 00 00 00 41 B2 C2 23   RCV72B-2233-01X
 CA 00 00 00 3D 39 F6 23   PIO72B-2231-14X

>
```

PS3 – Instrument Transformation Matrix

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

```
>ps3
Last Save Time: 06/08/08,08:10:19.41
Profiling Beams: 4
Freq(Hz) 2457600
Dia (mm) 38
Beam Positions:
 Bm        X        Y        Z        P        R        E
  1   0.0000   0.0000   0.0000   0.0000   0.0000  45.0000
  2   0.0000   0.0000   0.0000   0.0000   0.0000  45.0000
  3   0.0000   0.0000   0.0000   0.0000   0.0000  45.0000
```

```
  4   0.0000   0.0000   0.0000   0.0000   0.0000  45.0000
Instrument Transformation Matrix:
  0.7071 -0.7071  0.0000  0.0000
  0.0000  0.0000 -0.7071  0.7071
  0.3536  0.3536  0.3536  0.3536
  0.5000  0.5000 -0.5000 -0.5000
Stage:
Freq(Hz) 0
Dia (mm) 0
       X        Y        Z        P        R        E
  0.0000   0.0000   0.0000   0.0000   0.0000   0.0000

>
```

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

PT - Built-In Tests

Purpose	Sends/displays results of DVS system diagnostic test.
Format	PT*nn*
Range	*nn* = 0, 3, 11-16 (PT0 = Help menu)

Recommended Setting. Use as needed.

Description	These diagnostic tests check the major DVS modules and signal paths.

PT0 - Help

Sending the PT0 command will list the available PT commands, which perform diagnostic tests. The PT commands are not accepted while the DVS is pinging.

```
>PT0
Built In Tests
----------------
PT0 = Displays list of tests
PT3 = Receive path test
PT11 = Tests the FRAM memory
PT12 = Tests the RAM
PT13 = Tests the flash ROM
PT14 = Tests recorder memory
PT15 = Tests UART comms
PT16 = Tests RTC
```

PT3 - Receive Path

This test displays receive path characteristics. This test has two parts.

- Part 1 - The DVS pings without transmitting and displays the result of an autocorrelation function performed over 14 lag periods (only the first 8 are displayed). Ideally, you should see high correlation at near-zero lags, and then see decorrelation as the lags get longer. High correlation values at longer lags indicate interference is present.

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

```
pt3
Receive Path Test (Hard Limited):
        H-Gain W-BW        L-Gain W-BW        H-Gain N-BW        L-Gain N-BW
Correlation Magnitude (percent)
Lag Bm1 Bm2 Bm3 Bm4    Bm1 Bm2 Bm3 Bm4    Bm1 Bm2 Bm3 Bm4    Bm1 Bm2 Bm3 Bm4
  0 100 100 100 100    100 100 100 100    100 100 100 100    100 100 100 100
  1  89  87  89  88     82  82  79  78     79  77  78  76     76  76  72  74
  2  62  61  66  63     42  52  45  43     38  40  43  38     29  36  35  39
  3  29  38  46  40     10  28  21  19      7  17  21  13     16  10  13  17
  4   7  20  28  29     25  15  10  11     29   5   8   2     45   4   5   7
  5   6  14  17  21     31   9   6   9     29   3   8  10     46   6   3   2
  6   8   9  10  15     26  10   5   8     16   6   8  10     31   3   2   4
  7   4   6   3   9     17  12   3   5      8   6   7   5      8   3   3   2
Sin Duty Cycle (percent)
     35  49  48  53     49  47  47  41     34  38  53  47     46  50  50  51
Cos Duty Cycle (percent)
     51  54  56  51     46  46  47  44     49  56  55  53     44  54  49  44
RSSI Noise Floor (counts)
     68  78  77  85     60  71  69  78     75  85  83  92     60  71  69  77

>
```

> **NOTE.** A functional DVS may show high correlation or high noise floor when this test is run in air due to interference. This test should be run in the deployed environment to achieve good results.

PT11 - FRAM Memory

The PT11 command performs the following tests of the FRAM (used to store recorder directory information):

1. Pattern Test: Writes 4 patterns to each address in the RFRAM space, and reads back from these addresses to make sure the data was correctly written.
2. Address Test: This tests the address bus by writing consecutive number to addresses that have only 1 bit set (i.e. write 1 to 0x00000001, then write 2 to 0x00000002, then write 3 to 0x00000004, and so on). After writing to these locations, we read the data back and verify that it is what we'd expect.
3. Data Test: This tests the data bus in FRAM memory by writing data values that have only one bit set (i.e. 0x01, 0x02, 0x04) to consecu-

tive locations in memory. Then we read back to make sure that all data was written properly.

Failure on any of these tests will produce a FAIL result for PT11.

On a DVS equipped with an inductive modem, the modem has a pre-programmed time-out of ~ 2 to 3 minutes. If this test is given over the modem, extra characters will be output periodically to keep the modem interface alive during the test.

```
pt11

FRAM test... PASS

>
```

PT12 - RAM

The PT12 command performs the tests described for PT11 above on the RAM. On a DVS equipped with an inductive modem, the modem has a pre-programmed time-out of ~2 to 3 minutes. If this test is given over the modem, extra characters will be output periodically to keep the modem interface alive during the test.

```
pt12

RAM test... PASS

>
```

PT13 - ROM

The PT13 command performs a test of the flash ROM by comparing the CRC of the data in ROM with the CRC value stored in FLASH. If the values differ, PT13 will result in a FAIL. On a DVS equipped with an inductive modem, the modem has a pre-programmed time-out of ~2 to 3 minutes. If this test is given over the modem, extra characters will be output periodically to keep the modem interface alive during the test.

```
pt13
ROM Test.................PASS

>
```

PT14 - Recorder Memory

PT14 tests the recorder memory. This test performs a read/write to every address on the recorder. A FAIL result indicates the test was unable to read/write to one or more addresses on the recorder. Erase the recorder before running the test.

```
pt14

Performing Recorder Flash Test...

Blank check DEV0:

0
Device 1 not blank @ addr=000000 [7f]
000000:  7f 8a a5 02 06 3f 81 01 00 00 d6 07 08 1c 0b 00
000010:  30 01 00 0a 00 00 00 01 11 01 01 00 a9 6b 96 ff
000020:  fe ff 00 80 3b 5f 00 00 00 00 00 80 03 00 00 00
000030:  00 80 00 00 00 00 00 80 1f 64 00 68 00 01 00 82
000040:  05 00 80 00 80 00 80 00 80 00 80 00 80 00 80 00
000050:  80 00 80 00 80 00 80 00 80 00 80 00 80 00 80 00
000060:  80 00 80 00 80 00 80 00 80 4c 57 52 5b 44 4e 4d
000070:  55 44 4e 4c 54 44 4e 4c 54 44 4f 4c 54 13 14 09
000080:  09 06 07 04 05 07 06 05 04 07 05 04 04 06 04 04
000090:  03 00 00 64 00 00 00 64 00 00 00 64 00 00 00 64
0000a0:  00 00 00 64 00 21 1f 7f 8a a5 02 06 3f 81 02 00
0000b0:  00 d6 07 08 1c 0b 00 31 01 00 0a 00 00 00 01 11
0000c0:  01 01 00 aa 6b 97 ff ff ff 00 80 3a 5f 00 00 00
0000d0:  00 00 80 01 00 00 00 00 80 02 00 00 00 00 80 1f
0000e0:  64 00 68 00 01 00 82 05 00 80 00 80 00 80 00 80
0000f0:  00 80 00 80 00 80 00 80 00 80 00 80 00 80 00 80
000100:
```

CAUTION. This test performs a read/write to every address in the recorder and will therefore overwrite any data stored. For this reason, the test will check that the recorder has been erased and will terminate with an error message if any data is found prior to beginning the read/write procedure.

NOTE. Because of the length of time required (several minutes) this test is not available over the modem interface.

PT15 - UART Communications

PT15 tests the communications interfaces (i.e. UARTs).

```
pt15
Communications test.....PASS

>
```

PT16 - Real Time Clock

PT16 tests the Real Time Clock

```
pt16
RTC test................PASS

>
```

PT17 –Compass

PT17 tests the compass. The compass is queried to verify the communication path and the output verified (not marked bad by the compass). The output of heading, pitch and roll are shown in the test results.

```
>pt17
Compass test............PASS  [ 342.644775, -0.093291, 179.757675 ]

>
```

PT18 –Temperature Sensor

PT18 tests the temperature sensor. The temperature sensor is queried to verify the communication path and the output verified (not marked bad by the thermistor). The output of the temperature sensor is shown in the test results.

```
>pt18
Temperature test........PASS  [ 24.384951 ]

>
```

8.5 Sensor Commands

The DVS uses the following commands for calibrating the sensors.

8.5.1 Available Sensor Commands

```
>s?
Available Commands:

SC ---------------------- Compass Calibration [0=new,1=factory]
SG 50 1  ---------------- Configure Compass Cal (nPts[1-50] StabChk[1,0])
S? ---------------------- Display S-Command Menu
```

8.5.2 Sensor Commands Descriptions

SC – Compass Calibration

Purpose Calibrates or resets the TCM5 compass.

Format SC*x*

Range *x* = 0 (Perform field calibration),
x = 1 (Restore factory calibration)

Default N/A

> **Recommended Setting.** Use the DVS software to calibrate the compass.

Description Use the SC command to calibrate the compass or reset the compass to the factory calibration.

SG – Configure Compass Calibration

Purpose The SG command configures the compass calibration.

Format SG *nPts StabChk*

Range *nPts* = 1 to 50, *StabChk* = 1, 0

Default SG 50 1

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

Description *nPts* is the number of samples that the TCM5 compass will take during a field calibration.

StabChk is a flag that indicates whether or not the TCM5 will require the compass to be stable when it takes a sample during calibration. The default value is 1, which requires stability. If the stability flag is off, then the TCM5 will take a sample whenever the minimum position change criteria have been met. Otherwise, it waits for the DVS to stop moving before it takes a sample.

8.6 Timing Commands

The following commands let you set the timing of various DVS profiling functions.

8.6.1 Available Timing Commands

This section lists the available Timing commands.

```
>t?
Available Commands:

TE 00:10:00.00 ---------- Time Between Ensembles
TF 00/00/00,00:00:00 ---- Set First Ping Time (yy/mm/dd,hh:mm:ss)
TP 00:30.00 ------------- Time Between Samples
TS 06/08/28,19:00:59.61 - Set System Date and Time (yy/mm/dd,hh:mm:ss)
T? ---------------------- Display T-Command Menu
```

8.6.2 Timing Command Descriptions

TE – Time Between Ensembles

Purpose	Sets the time between ensembles.
Format	TE *hh*:*mm*:*ss*.*ff*
Range	*hh* = hour (00 to 12) *mm* = minute (00 to 59) *ss* = second (00 to 59) *ff* = hundreds of seconds (00 to 59)
Default	TE 00:10:00.00 (i.e. 10 minutes)

Recommended Setting. Set using the DVS Software.

Description	Sets the time between ensembles. An ensemble is one or more samples averaged together, where the number of samples per ensemble is set by the WP command.

NOTES.

1. If TE < TP, then TP will dominate.
2. The time tag for each ensemble is the time of the first ping of that ensemble.
3. The delimiters are optional, and may be spaces.

TF – Time of First Ping

Purpose Sets the time the DVS wakes up to start data collection.

Format TF*yy/mm/dd, hh:mm:ss*

Range
yy = year 00-99
mm = month 01-12
dd = day 01-31 (leap years are accounted for)
hh = hour 00-23
mm = minute 00-59
ss = second 00-59

Recommended Setting. Set using the DVS Software.

Description The TF command delays the start of data collection. This lets you deploy the DVS in the Standby mode and have it automatically start data collection at a preset time (typically used in battery operated instruments). When the command is given to the DVS to start pinging, TF is tested for validity. If valid, the DVS sets its alarm clock to TF, goes to sleep, and waits until time TF before beginning the data collection process.

Example If you want the exact time of the first ping to be on November 23, 2006 at 1:37:15 pm, you would enter TF06/11/23, 13:37:15. If you want the DVS to begin pinging immediately after receiving the CS command (see notes), do not enter a TF command value.

NOTES.

1. Although you may send a TF command to the DVS, you also must send the CS command before deploying the DVS.
2. If the entry is not valid, the DVS sends an error message and does not update the wake-up time.
3. Sending a <BREAK> clears the TF time.
4. The delimiters are optional, and may be spaces.

TP – Time Between Samples

Purpose Sets the time between samples.

Format TP *mm:ss.ff*

Range
mm = minute (00-30)
ss = second (00-59)
ff = hundreds of seconds (00 to 99)

Default TP 00:30:00.00 (i.e. 30 seconds)

Recommended Setting. Set using the DVS Software.

Description: Sets the time between samples (from 1 second to 30 minutes). A sample is defined as a 1-second average of X sub-pings, where X is the maximum number of sub pings possible. This value is also the minimum time that can occur between samples.

NOTE. If TE < TP, then TP will dominate. The delimiters are optional, and may be spaces.

NOTE. TRDI is introducing new terminology with DVS systems.

To minimize power consumption, the DVS was designed to measure in bursts of one second, with each such burst referred to as a “sample”. During this one second burst, the DVS will make as many asynchronous measurements as it can of velocity, temperature and Heading / Pitch / Roll (HPR) (see Figure 47).

The number of velocity measurements possible in one second depends on the setup (bin size, number of bins, speed of sound, etc.).

Multiple samples can be combined to form an ensemble, and in a departure from other TRDI products, the TP command sets the time between the start of samples rather than the perhaps more familiar time between pings (see Figure 48).

The number of temperature measurements per sample is typically one or two, and the number of HPR measurements is ~8.

If the velocity measurements are taken at a faster rate than the HPR measurements, then the HPR is updated as each new measurement is available. The mean and standard deviation of the HPR are measured for each sample.

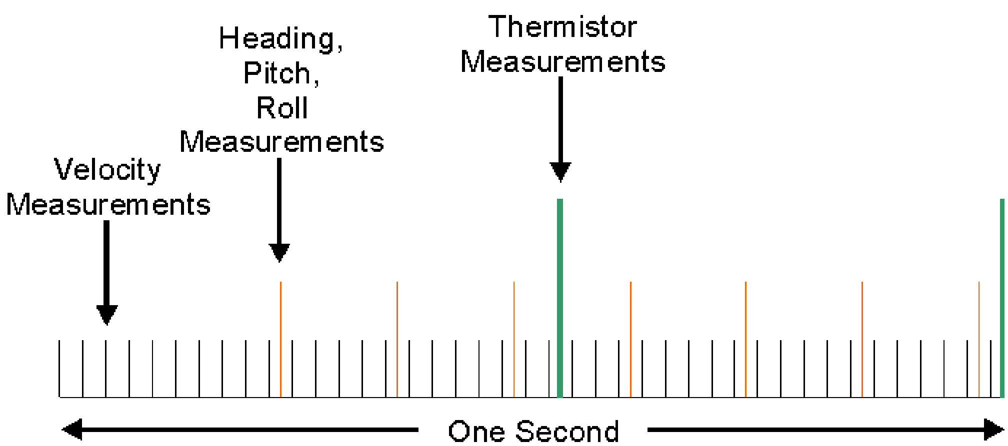


Figure 47. One Second Sample

TS – Set System Date and Time

Purpose Sets the DVS's internal real-time clock.

Format TS *yy/mm/dd, hh:mm:ss*

Range

yy	= year	00 to 99
mm	= month	01 to 12
dd	= day	01 to 31
hh	= hour	00 to 23
mm	= minute	00 to 59
ss	= second	00 to 59

Recommended Setting. Set using the DVS Software.

Example TS98/06/17, 13:15:00 sets the real-time clock to 1:15:00 pm, June 17, 1998.

NOTES.

1. When the DVS receives the carriage return after the TS-command, it enters the new time into the real-time clock and sets hundredths of seconds to zero.

2. If the entry is not valid, the DVS sends an error message and does not update the real-time clock.

8.7 Water Profiling Commands

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

8.7.1 Available Water Profiling Commands

This section lists the available Water Profiling commands.

```
>w?
Available Commands:

WD 111100000 ----------- Data Out {v;c;a;p;s;*;*;*;*}
WF 0100 ----------------- Blanking Distance (cm)
WN 005 ------------------ Number of Bins [1-5]
WP 001 ------------------ Number of Samples [1-999]
WS 0025 ----------------- Bin Size (cm)
W? ---------------------- Display W-Command Menu

>
```

8.7.2 Water Profiling Command Descriptions

WD – Data Out

Purpose Sets the data types that get output when the PD0 output format is selected:

Format WD *abc def ghi*

Range Firmware switches (see description)

Default WD 111 100 000

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

Description WD uses firmware switches to tell the DVS the types of data to collect. Valid only when PD0 output format is selected. The DVS always collects header data, fixed and variable leader data, and checksum data. Setting a bit to one tells the DVS to collect that data type. The bits are described as follows:

a = Velocity	*d* = Percent good	*g* = Reserved
b = Correlation	e = Status	*h* = Reserved
c = Echo Intensity	*f* = Reserved	*I* = Reserved

Example WD 111100000 (default) tells the DVS to collect velocity, correlation magnitude, echo intensity, and percent-good.

> **NOTE.** Each bit can have a value of one or zero. Setting a bit to one means output data, zero means suppress data. Spaces in the command line are allowed.

WF – Blanking Distance

Purpose — Moves the location of first depth cell away from the transducer head to allow the transmit circuits time to recover before the receive cycle begins.

Format — WFnnn

Range — nnn = 0 to 500 cm

Default — WF100

Recommended Setting. Set using the DVS Software.

Description — WF positions the start of the first depth cell at some vertical distance from the transducer head. When the DVS transmits it can excite resonances internally and in the mounting structure which may feedback into the near measurements and bias them toward zero (since the ringing will have zero Doppler shift). Set WF to allow the DVS transmit circuits time to recover before beginning the receive cycle.

CAUTION. The DVS will not get valid profile data past 5 meters; if you set a 3 meter blanking distance, you should expect to only get up to 2 meters of good profile data.

CAUTION. The minimum Blanking Distance for the DVS is 30 cm.

NOTES.

1. The distance to the middle of depth cell #1 is a function of blank after transmit (WF), depth cell size (WS), and speed of sound. The fixed leader data contains this distance.
2. Small WF values may show ringing/recovery problems in the first depth cells that cannot be screened by the DVS. We recommend a blank zone of at least 30 cm to avoid any possibility of ringing.

WN – Number of Bins

Purpose — Sets the number of bins (depth cells) over which the DVS collects data.

Format — WNnnn

Range — nnn = 1 to 5

Default — WN5

Recommended Setting. Set using the DVS Software.

Description The range of the DVS is set by the number of bins (WN) times the size of each bin (WS – Bin Size).

WP – Number of Samples

Purpose Selects the number of samples per ensemble.

Format WP*nnn*

Range *nnn* = 1 to 999

Default WP1

Recommended Setting. Set using the DVS Software.

Description WP sets the number of samples per ensemble before sending/recording the data.

NOTE. TRDI is introducing new terminology for the WP command with DVS systems.

To minimize power consumption, the DVS was designed to measure in bursts of one second, with each such burst referred to as a “sample”. During this one second burst, the DVS will make as many asynchronous measurements as it can of velocity, temperature and Heading / Pitch / Roll (HPR) (see Figure 47).

The number of velocity measurements possible in one second depends on the setup (bin size, number of bins, speed of sound, etc.).

Multiple samples can be combined to form an ensemble, and in a departure from other TRDI products, the WP command sets the number of samples desired in the ensemble rather than the perhaps more familiar number of pings per ensemble (see Figure 48).

However, since the actual number of pings used in the sample may be of more interest than the number of samples selected, the actual number of pings is stored in the data recorded.

The number of temperature measurements is typically one or two, and the number of HPR measurements is ~8.

If the velocity measurements are taken at a faster rate than the HPR measurements, then the HPR is updated as each new measurement is available. The mean and standard deviation of the HPR are measured for each sample.

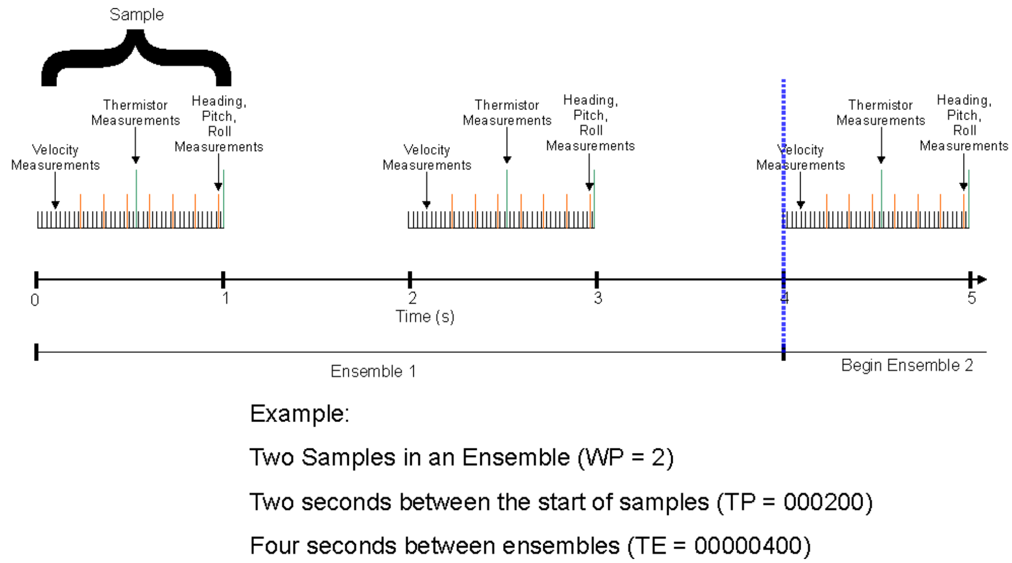


Figure 48. Samples

WS – Bin Size

Purpose	Selects the volume of water for one measurement cell.
Format	WS*nnn*
Range	*nnn* = 3 to 500 cm
Default	WS25

Recommended Setting. Set using the DVS Software.

Description — The DVS collects data over a variable number of bins (depth cells). The WS command sets the size of each bin in vertical centimeters.

NOTE. Bin sizes larger than 1 meter will cause closer samples to be weighted more heavily than farther samples due to the Signal to Noise drop-off. Therefore, if you want a 5-meter bin, for example, it is best to collect five 1-meter bins and average the resulting velocities together, as this will give a more correct answer.

9 Introduction to Output Data Format

This section shows the output data format of the DVS. DVS output data can be in either hexadecimal-ASCII or binary format. You can select this option through the CF-command (see the CF - Flow Control). We explain the output data formats in enough detail to let you create your own data processing or analysis programs (see How to Decode a DVS Ensemble).

The user can select to use PD0 or and the new PD20 data output formats. The PD0 format is the standard data type that is common to other ADCP instruments, and is compatible with existing software that can read and decode PD0 data. The new PD20 format is be composed of a PD0-like structure, and can be converted to PD0 formatted data.

9.1 Hexadecimal-ASCII Output Data

Use the hexadecimal-ASCII (Hex ASCII) format (CFxx0xx) when you are viewing raw DVS data on a computer/dumb terminal. This format uses the standard ASCII codes for 0 through F to represent numeric values as hexadecimal digits. Other standard ASCII characters (text) and control commands (carriage return, line feed, end of file, etc.) are interpreted normally. In the Hex ASCII mode, the DVS sends data in one line of ASCII characters. There are no carriage returns and/or line feed sequences (CR/LF) sent from the DVS with CFxx0xx.

NOTE. Hex ASCII PD0 data is not supported by TRDI's software.

9.2 Binary Output Data Format

Use the binary format (CFxx1xx) when recording/processing DVS data on an external device. The binary format uses less storage space and has a faster transmission time than the Hex ASCII format. A dumb terminal is of little use in binary format because the terminal interprets some of the data as control characters.

10 PD20 Output Data Format

The default Output Data Format for the DVS is PD20. Because the DVS has only 16 MB of on-board memory, this data format was developed to minimize the recording of redundant data. The DVS software converts PD20 data to TRDI standard PD0 format for use with other TRDI software.

NOTE. All of TRDI's software supports binary PD0 formatted data only. Use the *DVS* software to convert PD20 formatted data to PD0.

HEADER (6 BYTES)
SCALAR DATA (57 BYTES)
ARRAY DATA (20 x # Bins +2)
CHECKSUM (2 BYTES)

Figure 49. PD20 Standard Output Data Buffer Format

The Array data format is in bytes per bin. For example, if the WN command (number of bins) = 5 (default), the required data buffer storage space is 167 bytes per ensemble.

```
  6  BYTES OF HEADER DATA
 57  BYTES OF SCALAR DATA
102  BYTES OF ARRAY DATA (20 x # Bins +2)
  2  BYTES OF CHECKSUM DATA
-----------------------------------------
167  BYTES OF DATA PER ENSEMBLE
```

10.1 PD20 Header Data Format

BIT POSITIONS

BYTE	7	6	5	4	3	2	1	0	
1	HEADER ID (7Fh)								LSB
2	DATA SOURCE ID (8Ah)								MSB
3	SIZE								
4	NUMBER OF DATA TYPES								
5	POINTER TO SCALAR DATA								
6	POINTER TO ARRAY DATA								

See Table 23 for a description of the fields.

Figure 50. PD20 Header Data Format

Header information is the first item sent by the DVS to the output buffer. The DVS always sends the Least Significant Byte (LSB) first.

Table 23: PD20 Header Data Format

Binary Byte	Field	Value	Description
1, 2	ID	0x8A7F	Header ID - Fixed Value
3	Size	0-255	Based on number of bins selected
4	# of Types	0-255	Default will be 2
5	Pointer to Fixed Data	0-255	Default will be 6
6	Pointer to Variable Data	0-255	Default will be 5

10.2 PD20 Scalar Data Format

BIT POSITIONS

BYTE	7	6	5	4	3	2	1	0
1.	SCALAR DATA ID							
2.–4.	ENSEMBLE #							
5.–6.	YEAR							
7.	MONTH							
8.	DAY							
9.	HOUR							
10.	MINUTE							
11.	SECOND							
12.–13.	TIME BETWEEN SAMPLES							
14.–15.	NUMBER OF PINGS (see note 4 page 143)							
16.–17.	BUILT IN TESTS							
18.–21.	SENSOR SOURCE							
22.	BATTERY VOLTAGE							
23.–24.	AVERAGE HEADING							
25.–26.	AVERAGE PITCH							
27.–28.	AVERAGE ROLL							
29.–30.	RESERVED FOR FUTURE USE							
31.–34.	AVERAGE TEMPERATURE							

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35.	RESERVED
36.	
37.	
38.	
39.	STANDARD DEVIATION HEADING
40.	
41.	STANDARD DEVIATION PITCH
42.	STANDARD DEVIATION ROLL
43.	RESERVED FOR FUTURE USE
44.	
45.	STANDARD DEVIATION TEMPERATURE
46.	
47.	RESERVED
48.	
49.	
50.	
51.	COORDINATE SYSTEM
52.	BIN SIZE
53.	
54.	BIN 1 DISTANCE
55.	
56.	NUMBER OF ENSEMBLES
57.	

Figure 51. PD20 Scalar Data Format

NOTE. TRDI is introducing new terminology for the WP command with DVS systems.

1. To minimize power consumption, the DVS was designed to measure in bursts of one second, with each such burst referred to as a “sample”. During this one second burst, the DVS will make as many asynchronous measurements as it can of velocity, temperature and Heading / Pitch / Roll (HPR) (see Figure 47).

2. The number of velocity measurements possible in one second depends on the setup (bin size, number of bins, speed of sound, etc.).

3. Multiple samples can be combined to form an ensemble, and in a departure from other TRDI products, the WP command sets the number of samples desired in the ensemble rather than the perhaps more familiar number of pings per ensemble (see Figure 48).

4. However, since the actual number of pings used in the sample may be of more interest than the number of samples selected, the actual number of pings is stored in the data recorded.

5. The number of temperature measurements is typically one or two, and the number of HPR measurements is ~8.

6. If the velocity measurements are taken at a faster rate than the HPR measurements, then the HPR is updated as each new measurement is available. The mean and standard deviation of the HPR are measured for each sample.

Scalar data refers to the non-dynamic DVS data that only changes when you change certain commands. Scalar data also contain hardware information. The DVS always sends Scalar data as output data (LSBs first).

Table 24: PD20 Scalar Data Format

Byte	Value	Description
1	0x81	Scalar Value ID
2-4	Start at 1	Ensemble # Increments from 1 with each ensemble
5-6	2006	4-digit year
7	1-12	Month
8	1-31	Day
9	0-23	Hour
10	0-59	Minute
11	0-59	Second
12-13	1-65535	Time Between Samples (s). Set by DVS software in seconds
14-15		Number of pings (see note 2 and 4 page 143)
16-17		Built In Tests
18-21		Sensor Source. Default will be 1022202
22	use 8 as offset	Battery Voltage LSB 0.1 volts; all values are offset by 8VDC
23-24		Average Heading LSB = 0.01 degrees (0-35999)
25-26		Average Pitch LSB = 0.01 degrees(-7000 to+7000)
27-28		Average Roll LSB = 0.01 degrees(-7000 to +7000)
29-30		Average Omega
31-34		Average Temp LSB = 0.001 degrees C (-5000 to +45000)
35-38		Reserved for TRDI use
39-40		Std Dev Heading LSB = 0.01 degrees (0 to 36000)
41		Std Dev Pitch LSB = 0.01 degrees (0 to 255)
42		Std Dev Roll LSB = 0.01 degrees (0 to 255)
43-44		Std Dev Omega
45-46		Std Dev Temp LSB = 0.001 degrees C (0 to 1000)
47-50		Reserved for TRDI use
51	0x1F	Coordinate System xxxC CT3B; CC=coords; T=tilts; 3=paritial; B=binmap
52-53		Bin Size LSB = 1 cm
54-55		Bin 1 Distance LSB = 1 cm
56-57		Number of Ensembles Always = 1 for raw ensembles

10.3 PD20 Array Data Format

BYTE	BIT POSITIONS 7	6	5	4	3	2	1	0
1	ARRAY DATA ID							
2	# BINS							
8*(n-1)+2	Bin n Velocity 1							
8*(n-1)+4	Bin n Velocity 2							
8*(n-1)+6	Bin n Velocity 3							
8*(n-1)+8	Bin n Velocity 4							
↓	**Continues for n bins**							
8*N+4*(n-1)+2	Bin n Amplitude 1							
8*N+4*(n-1)+3	Bin n Amplitude 2							
8*N+4*(n-1)+4	Bin n Amplitude 3							
8*N+4*(n-1)+5	Bin n Amplitude 4							
↓	**Continues for n bins**							
12*N+4*(n-1)+2	Bin n Correlation 1							
12*N+4*(n-1)+3	Bin n Correlation 2							
12*N+4*(n-1)+4	Bin n Correlation 3							
12*N+4*(n-1)+5	Bin n Correlation 4							
↓	**Continues for n bins**							
16*N+4*(n-1)+2	Bin n % Good 1							
16*N+4*(n-1)+3	Bin n % Good 2							
16*N+4*(n-1)+4	Bin n % Good 3							
16*N+4*(n-1)+5	Bin n % Good 4							
↓	**Continues for n bins**							

Figure 52. PD20 Array Data Format

NOTE. n = bin number (1 through 5), N = number of bins (1 through 5)

Array data refers to the dynamic DVS data (velocity, amplitude, correlation, and percent-good) that change with each ping. The DVS always sends Array data as output data (LSBs first).

Table 25: PD20 Array Data Format

Byte	Value	Description
1	0x82	ID
2	0-5	# Bins
8*(n-1)+2	-32768 to +32767	Bin n Velocity 1 LSB = 0.001 m/s; -32768=BAD
8*(n-1)+4	-32768 to +32767	Bin n Velocity 2 LSB = 0.001 m/s; -32768=BAD
8*(n-1)+6	-32768 to +32767	Bin n Velocity 3 LSB = 0.001 m/s; -32768=BAD
8*(n-1)+8	-32768 to +32767	Bin n Velocity 4 LSB = 0.001 m/s; -32768=BAD
8*N+4*(n-1)+2	0-255	Bin n Amplitude 1 LSB = 1 count
8*N+4*(n-1)+3	0-255	Bin n Amplitude 2 LSB = 1 count
8*N+4*(n-1)+4	0-255	Bin n Amplitude 3 LSB = 1 count
8*N+4*(n-1)+5	0-255	Bin n Amplitude 4 LSB = 1 count
12*N+4*(n-1)+2	0-255	Bin n Correlation 1 LSB = 1 count
12*N+4*(n-1)+3	0-255	Bin n Correlation 2 LSB = 1 count
12*N+4*(n-1)+4	0-255	Bin n Correlation 3 LSB = 1 count
12*N+4*(n-1)+5	0-255	Bin n Correlation 4 LSB = 1 count
16*N+4*(n-1)+2	0-100	Bin n % Good 1 LSB = 1%
16*N+4*(n-1)+3	0-100	Bin n % Good 2 LSB = 1%
16*N+4*(n-1)+4	0-100	Bin n % Good 3 LSB = 1%
16*N+4*(n-1)+5	0-100	Bin n % Good 4 LSB = 1%

NOTE. n = bin number (1 through 5), N = number of bins (1 through 5)
Total number of bytes of Array Data = 20*N+2.

10.4 PD20 Checksum Data Format

BIT POSITIONS

BYTE	7	6	5	4	3	2	1	0	
1	CHECKSUM DATA								LSB
2									MSB

Figure 53. PD20 Checksum Data Format

Table 26: PD20 Checksum Data Format

Byte	Value	Description
1,2	20*N+62	This field contains a modulo 65536 checksum. The DVS computes the checksum by summing all the bytes in the output buffer excluding the checksum.

NOTE. N = number of bins (1 through 5).
Total number of bytes of PD20 Data = 20*N+67.

11 PD0 Output Data Format

The following description is for the PD0 DVS output data format. Figure 55 through Figure 61 shows the ASCII and binary data formats for the DVS PD0 mode. Table 27 through Table 35 defines each field in the output data structure.

After completing a data collection cycle, the DVS immediately sends a data ensemble. The following pages show the types and sequence of data that you may include in the DVS output data ensemble and the number of bytes required for each data type. The DVS sends all the data for a given type for all depth cells and all beams before the next data type begins.

The DVS can be set to collect velocity, correlation data, echo intensity, and percent good data with the WD command. The data, preceded by ID code 7F7F, contains header data (explained in Table 27). The fixed and variable leader data is preceded by ID codes 0000 and 8000, (explained in Table 28 and Table 29). The DVS always collects Header and Leader.

The remaining lines include velocity (ID Code: 0001), correlation magnitude (0002), echo intensity (0003), and percent good (0004). The final field is a data-validity checksum.

ALWAYS OUTPUT	**HEADER** (6 BYTES + [2 x No. OF DATA TYPES])
	FIXED LEADER DATA (59 BYTES)
	VARIABLE LEADER DATA (65 BYTES)
WD command WP command	**VELOCITY** (2 BYTES + 8 BYTES PER DEPTH CELL)
	CORRELATION MAGNITUDE (2 BYTES + 4 BYTES PER DEPTH CELL)
	ECHO INTENSITY (2 BYTES + 4 BYTES PER DEPTH CELL)
	PERCENT GOOD (2 BYTES + 4 BYTES PER DEPTH CELL)
ALWAYS OUTPUT	**RESERVED** (2 BYTES)
	CHECKSUM (2 BYTES)

Figure 54. PD0 Standard Output Data Buffer Format

Some data outputs are in bytes per depth cell. For example, if the WN command (number of depth cells) = 5 (default), WD command = WD 111 100 000 (default), WP command = 1 (default), the required data buffer storage space is 254 bytes per ensemble.

There are six data types output for this example: Fixed Leader, Variable Leader, Velocity, Correlation Magnitude, Echo Intensity, and Percent Good.

```
 18  BYTES OF HEADER DATA (6 + [2 x 6 Data Types])
 59  BYTES OF FIXED LEADER DATA (FIXED)
 65  BYTES OF VARIABLE LEADER DATA (FIXED)
 42  BYTES OF VELOCITY DATA (2 + 8 x 5)
 22  BYTES OF CORRELATION MAGNITUDE DATA (2 + 4 x 5)
 22  BYTES OF ECHO INTENSITY (2 + 4 x 5)
 22  BYTES OF PERCENT-GOOD DATA (2 + 4 x 5)
  2  BYTES OF RESERVED FOR TRDI USE (FIXED)
  2  BYTES OF CHECKSUM DATA (FIXED)
------------------------------------------
254  BYTES OF DATA PER ENSEMBLE
```

11.1 Header Data Format

BIT POSITIONS

BYTE	7 6 5 4 3 2 1 0	
1	HEADER ID (7Fh)	
2	DATA SOURCE ID (7Fh)	
3	NUMBER OF BYTES IN ENSEMBLE	LSB
4		MSB
5	SPARE	
6	NUMBER OF DATA TYPES	
7	OFFSET FOR DATA TYPE #1	LSB
8		MSB
9	OFFSET FOR DATA TYPE #2	LSB
10		MSB
11	OFFSET FOR DATA TYPE #3	LSB
12		MSB
↓	(SEQUENCE CONTINUES FOR UP TO N DATA TYPES)	↓
2N+5	OFFSET FOR DATA TYPE #N	LSB
2N+6		MSB

See Table 27 for a description of the fields.

Figure 55. Binary Header Data Format

Header information is the first item sent by the DVS to the output buffer. The DVS always sends the Least Significant Byte (LSB) first.

Table 27: Header Data Format

Hex Digit	Binary Byte	Field	Description
1,2	1	HDR ID / Header ID	Stores the header identification byte (7Fh).
3,4	2	HDR ID / Data Source ID	Stores the data source identification byte (7Fh for the DVS).
5-8	3,4	Bytes / Number of bytes in ensemble	This field contains the number of bytes from the start of the current ensemble up to, but not including, the 2-byte checksum (Figure 61).
9,10	5	Spare	Undefined.
11,12	6	No. DT / Number of Data Types	This field contains the number of data types selected for collection. By default, fixed/variable leader, velocity, correlation magnitude, echo intensity, and percent good are selected for collection. This field will therefore have a value of six (4 data types + 2 for the Fixed/Variable Leader data).
13-16	7,8	Address Offset for Data Type #1 / Offset for Data Type #1	This field contains the internal memory address offset where the DVS will store information for data type #1 (with this firmware, always the Fixed Leader). Adding "1" to this offset number gives the absolute Binary Byte number in the ensemble where Data Type #1 begins (the first byte of the ensemble is Binary Byte #1).
17-20	9,10	Address Offset for Data Type #2 / Offset for Data Type #2	This field contains the internal memory address offset where the DVS will store information for data type #2 (with this firmware, always the Variable Leader). Adding "1" to this offset number gives the absolute Binary Byte number in the ensemble where Data Type #2 begins (the first byte of the ensemble is Binary Byte #1).
21-24 thru 2n+13 to 2n+16	11,12 thru 2n+5, 2n+6	Address Offsets for Data Types #3-n / Offset for Data Type #3 through #n	These fields contain internal memory address offset where the DVS will store information for data type #3 through data type #n. Adding "1" to this offset number gives the absolute Binary Byte number in the ensemble where Data Types #3-n begin (first byte of ensemble is Binary Byte) #1).

11.2 Fixed Leader Data Format

BIT POSITIONS

BYTE	7	6	5	4	3	2	1	0	
1	FIXED LEADER ID								LSB 00h
2									MSB 00h
3	CPU F/W VER.								
4	CPU F/W REV.								
5	SYSTEM CONFIGURATION								LSB
6									MSB
7	REAL/SIM FLAG								
8	LAG LENGTH								
9	NUMBER OF BEAMS								
10	NUMBER OF CELLS								
11	PINGS PER ENSEMBLE								LSB
12									MSB
13	DEPTH CELL LENGTH								LSB
14									MSB
15	BLANK AFTER TRANSMIT								LSB
16									MSB
17	PROFILING MODE								
18	LOW CORR THRESH								
19	NO. CODE REPS								
20	%GOOD MINIMUM								
21	ERROR VELOCITY MAXIMUM								LSB
22									MSB
23	MINUTES								
24	SECONDS								
25	HUNDREDTHS								
26	COORDINATE TRANSFORM								
27	HEADING ALIGNMENT								LSB
28									MSB

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29	HEADING BIAS	LSB
30		MSB
31	SENSOR SOURCE	
32	SENSORS AVAILABLE	
33	BIN 1 DISTANCE	
34		
35	XMIT PULSE LENGTH BASED ON	LSB
36		MSB
37	(starting cell) WP REF LAYER AVERAGE (ending cell)	LSB
38		MSB
39	FALSE TARGET THRESH	
40	SPARE	
41	TRANSMIT LAG DISTANCE	LSB
42		MSB
43	CPU BOARD SERIAL NUMBER	LSB
↓		↓
50		MSB
51	SYSTEM BANDWIDTH	LSB
52		MSB
53	SYSTEM POWER	
54	SPARE	
↓		
59		

See Table 28 for a description of the fields

Figure 56. Fixed Leader Data Format

Fixed Leader data refers to the non-dynamic DVS data that only changes when you change certain commands. Fixed Leader data also contain hardware information. The DVS always sends Fixed Leader data as output data (LSBs first).

Table 28: Fixed Leader Data Format

Hex Digit	Binary Byte	Field	Description
1-4	1,2	FID / Fixed Leader ID	Stores the Fixed Leader identification word (00 00h).
5,6	3	fv / CPU F/W Ver.	Contains the version number of the CPU firmware.
7,8	4	fr / CPU F/W Rev.	Contains the revision number of the CPU firmware.
9-12	5,6	Sys Cfg / System Configuration	This field defines the DVS hardware configuration. Convert this field (2 bytes, LSB first) to binary and interpret as follows. LSB BITS 7 6 5 4 3 2 1 0 - - - - - 0 0 0 75-kHz SYSTEM - - - - - 0 0 1 150-kHz SYSTEM - - - - - 0 1 0 300-kHz SYSTEM - - - - - 0 1 1 600-kHz SYSTEM - - - - - 1 0 0 1200-kHz SYSTEM - - - - - 1 0 1 2400-kHz SYSTEM - - - - 0 - - - CONCAVE BEAM PAT. - - - - 1 - - - CONVEX BEAM PAT. - - 0 0 - - - - SENSOR CONFIG #1 - - 0 1 - - - - SENSOR CONFIG #2 - - 1 0 - - - - SENSOR CONFIG #3 - 0 - - - - - - XDCR HD NOT ATT. - 1 - - - - - - XDCR HD ATTACHED 0 - - - - - - - DOWN FACING BEAM 1 - - - - - - - UP-FACING BEAM MSB BITS 7 6 5 4 3 2 1 0 - - - - 0 0 0 0 15° BEAM ANGLE - - - - 0 0 0 1 20° BEAM ANGLE - - - - 0 0 1 0 30° BEAM ANGLE - - - - 0 0 1 1 OTHER BEAM ANGLE - - - - 0 1 1 1 25° BEAM ANGLE - - - - 1 1 0 0 45° BEAM ANGLE 0 1 0 0 - - - - 4-BEAM JANUS CONFIG 0 1 0 1 - - - - 5-BM JANUS CFIG DEMOD) 1 1 1 1 - - - - 5-BM JANUS CFIG.(2 DEMD)
13,14	7	Real/Sim Flag	This field is set by default as real data (0).

Continued next page

Table 28: Fixed Leader Data Format (continued)

Hex Digit	Binary Byte	Field	Description
15,16	8	Lag Length	Lag Length. The lag is the time period between sound pulses.
17,18	9	Number of Beams	Contains the number of beams used to calculate velocity data (not physical beams). The DVS needs only three beams to calculate water-current velocities. The fourth beam provides an error velocity that determines data validity. If only three beams are available, the DVS does not make this validity check. Table 33 (Percent-Good Data Format) has more information.
19,20	10	Number of Cells	Contains the number of depth cells over which the DVS collects data (WN-command). Scaling: LSD = 1 depth cell; Range = 1 to 128 depth cells
21-24	11,12	Pings Per Ensemble	Contains the number of pings used in the ensemble. The DVS collects samples. One sample consists of as many pings as the DVS can make in one second, and this number will depend on the exact setup. The WP command is used to set the number of samples that are included in an ensemble. The TP command is used to set the time between samples within an ensemble. **In this data output field however, the actual number of pings that were used in the ensemble is recorded.** For example, to collect five samples in the ensemble and each sample has 30 pings, then send WP5 as the WP command, but this field will record that 150 pings were in the ensemble. Scaling: LSD = 1 ping; Range = 0 to 16,384 pings
25-28	13,14	Depth Cell Length	Contains the length of one depth cell (WS-command). Scaling: LSD = 1 centimeter; Range = 1 to 6400 cm (210 feet)
29-32	15,16	Blank after Transmit	Contains the blanking distance used by the DVS to allow the transmit circuits time to recover before the receive cycle begins (WF-command). Scaling: LSD = 1 centimeter; Range = 0 to 9999 cm (328 feet)
33,34	17	Signal Processing Mode	Contains the Signal Processing Mode. This field will always be set to 1.
35,36	18	Low Corr Thresh	Contains the minimum threshold of correlation that water-profile data can have to be considered good data. Scaling: LSD = 1 count; Range = 0 to 255 counts
37,38	19	No. code reps	Contains the number of code repetitions in the transmit pulse. Scaling: LSD = 1 count; Range = 0 to 255 counts
39,40	20	%Good Minimum	Contains the minimum percentage of water-profiling pings in an ensemble that must be considered good to output velocity data. Scaling: LSD = 1 percent; Range = 1 to 100 percent
41-44	21,22	Error Velocity Threshold	This field, initially set by the WE-command, contains the actual threshold value used to flag water-current data as good or bad. If the error velocity value exceeds this threshold, the DVS flags all four beams of the affected bin as bad. Scaling: LSD = 1 mm/s; Range = 0 to 5000 mm/s

Table 28: Fixed Leader Data Format (continued)

Hex Digit	Binary Byte	Field	Description
45,46 47,48 49,50	23 24 25	Minutes Seconds Hundredths	These fields, set by the TP-command, contain the amount of time between samples in the ensemble. NOTE: The DVS automatically extends the ensemble interval (set by TE) if (WP x TP > TE).

51,52	26	Coordinate Transform	Contains the coordinate transformation processing parameters (EX-command). These firmware switches indicate how the DVS collected data.
			`xxx00xxx = NO TRANSFORMATION (BEAM COORDINATES)`
			`xxx01xxx = INSTRUMENT COORDINATES`
			`xxx10xxx = SHIP COORDINATES`
			`xxx11xxx = EARTH COORDINATES`
			`xxxxx1xx = TILTS (PITCH AND ROLL) USED IN SHIP OR EARTH TRANSFORMATION`
			`xxxxxx1x = 3-BEAM SOLUTION USED IF ONE BEAM IS BELOW THE CORRELATION THRESHOLD`
			`xxxxxxx1 = BIN MAPPING USED`

53-56	27,28	Heading Alignment	Contains a correction factor for physical heading misalignment (EA-command). Scaling: LSD = 0.01 degree; Range = -179.99 to 180.00 degrees
57-60	29,30	Heading Bias	Contains a correction factor for electrical/magnetic heading bias (EB-command). Scaling: LSD = 0.01 degree; Range = -179.99 to 180.00 degrees

61,62	31	Sensor Source	Contains the selected source of environmental sensor data (EZ-command). These firmware switches indicate the following.
			`FIELD        DESCRIPTION`
			`x1xxxxxx = CALCULATES EC (SPEED OF SOUND) FROM ED, ES, AND ET`
			`xx1xxxxx = USES ED FROM DEPTH SENSOR`
			`xxx1xxxx = USES EH FROM TRANSDUCER HEADING SENSOR`
			`xxxx1xxx = USES EP FROM TRANSDUCER PITCH SENSOR`
			`xxxxx1xx = USES ER FROM TRANSDUCER ROLL SENSOR`
			`xxxxxx1x = USES ES (SALINITY) FROM CONDUCTIVITY SENSOR`
			`xxxxxxx1 = USES ET FROM TRANSDUCER TEMPERATURE SENSOR`
			NOTE: If the field = 0, or if the sensor is not available, the DVS uses the manual command setting. If the field = 1, the DVS uses the reading from the internal sensor or an external synchro sensor (only applicable to heading, roll, and pitch). Although you can enter a "2" in the EZ-command string, the DVS only displays a 0 (manual) or 1 (int/ext sensor).

63,64	32	Sensor Avail	This field reflects which sensors are available. The bit pattern is the same as listed for the EZ-command (above).
65-68	33,34	dis1 / Bin 1 distance	This field contains the distance to the middle of the first depth cell (bin). This distance is a function of depth cell length (WS), the profiling mode, the blank after transmit distance (WF), and speed of sound. Scaling: LSD = 1 centimeter; Range = 0 to 65535 cm (2150 feet)

Table 28: Fixed Leader Data Format (continued)

Hex Digit	Binary Byte	Field	Description
69-72	35,36	Xmit pulse length	This field contains the length of the transmit pulse. When the DVS receives a <BREAK> signal, it sets the transmit pulse length as close as possible to the depth cell length (WS-command). Scaling: LSD = 1 centimeter; Range = 0 to 65535 cm (2150 feet)
73,74 75,76	37,38	Ref Lyr Avg (Starting cell, Ending cell)	Contains the starting depth cell (LSB, byte 37) and the ending depth cell (MSB, byte 38) used for water reference layer averaging (WL-command). Scaling: LSD = 1 depth cell; Range = 1 to 128 depth cells
77,78	39	False Target Threshold	Contains the threshold value used to reject data received from a false target, usually fish (WA-command). Scaling: LSD = 1 count; Range = 0 to 255 counts (255 disables)
79,80	40	Spare	Contains the CX-command setting. Range = 0 to 5
81-84	41,42	LagD / Transmit lag distance	This field, determined mainly by the setting of the WM-command, contains the distance between pulse repetitions. Scaling: LSD = 1 centimeter; Range = 0 to 65535 centimeters
85-100	43-50	CPU Board Serial Number	Contains the serial number of the CPU board.
101-105	51-52	System Bandwidth	Contains the WB-command setting. Range = 0 to 1
106-107	53	System Power	Contains the system power (CQ command) setting. Range 0 to 255.
108-121	54 - 59	Spare	

11.3 Variable Leader Data Format

BIT POSITIONS

BYTE	7	6	5	4	3	2	1	0	
1	VARIABLE LEADER ID								80h
2									00h
3	ENSEMBLE NUMBER								LSB
4									MSB
5	RTC YEAR {TS}								
6	RTC MONTH {TS}								
7	RTC DAY {TS}								
8	RTC HOUR {TS}								
9	RTC MINUTE {TS}								
10	RTC SECOND {TS}								
11	RTC HUNDREDTHS {TS}								
12	ENSEMBLE # MSB								
13	BIT RESULT								LSB
14									MSB
15	SPEED OF SOUND								LSB
16									MSB
17	DEPTH OF TRANSDUCER								LSB
18									MSB
19	HEADING								LSB
20									MSB
21	PITCH (TILT 1)								LSB
22									MSB
23	ROLL (TILT 2)								LSB
24									MSB
25	SALINITY								LSB
26									MSB
27	TEMPERATURE								LSB
28									MSB
29	MPT MINUTES								
30	MPT SECONDS								
31	MPT HUNDREDTHS								
32	HDG STD DEV								
33	PITCH STD DEV								
34	ROLL STD DEV								

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35	ADC CHANNEL 0	
36	ADC CHANNEL 1	
37	ADC CHANNEL 2	
38	ADC CHANNEL 3	
39	ADC CHANNEL 4	
40	ADC CHANNEL 5	
41	ADC CHANNEL 6	
42	ADC CHANNEL 7	
43	ERROR STATUS WORD (ESW)	LSB
44		
45		
46		MSB
47	RESERVED	
48		
49		
50		
51		
52		
53		
54		
55		
56		
57	SPARE	
58	RTC CENTURY	
59	RTC YEAR	
60	RTC MONTH	
61	RTC DAY	
62	RTC HOUR	
63	RTC MINUTE	
64	RTC SECOND	
65	RTC HUNDREDTH	

See Table 29 for a description of the fields.

Figure 57. Variable Leader Data Format

Variable Leader data refers to the dynamic DVS data (from clocks/sensors) that change with each ping. The DVS always sends Variable Leader data as output data (LSBs first).

Table 29: Variable Leader Data Format

Hex Digit	Binary Byte	Field	Description
1-4	1,2	VID / Variable Leader ID	Stores the Variable Leader identification word (80 00h).

5-8	3,4	Ensemble Number	This field contains the sequential number of the ensemble to which the data in the output buffer apply.
			Scaling: LSD = 1 ensemble; Range = 1 to 65,535 ensembles
			NOTE: The first ensemble collected is #1. At “rollover,” we have the following sequence:
			`1 = ENSEMBLE NUMBER 1`
			↓
			`65535 = ENSEMBLE NUMBER 65,535 | ENSEMBLE`
			`0 = ENSEMBLE NUMBER 65,536 | #MSB FIELD`
			`1 = ENSEMBLE NUMBER 65,537 | (BYTE 12)`
			`INCR.`

9,10	5	RTC Year	These fields contain the time from the DVS’s real-time clock (RTC) that the current data ensemble began. The TS-command (Set Real-Time Clock) initially sets the clock. The DVS does account for leap years.
11,12	6	RTC Month	
13,14	7	RTC Day	
15,16	8	RTC Hour	
17,18	9	RTC Minute	
19,22	10	RTC Second	
21,22	11	RTC Hundredths	
23-24	12	Ensemble # MSB	This field increments each time the Ensemble Number field (bytes 3,4) “rolls over.” This allows ensembles up to 16,777,215. See Ensemble Number field above.

25-28	13,14	BIT Result	This field contains the results of the DVS’s Built-in Test function. A zero code indicates a successful BIT result.
			`BYTE 13 BYTE 14 (BYTE 14 RESERVED FOR FUTURE USE)`
			`1xxxxxxx xxxxxxxx = RESERVED`
			`x1xxxxxx xxxxxxxx = RESERVED`
			`xx1xxxxx xxxxxxxx = RESERVED`
			`xxx1xxxx xxxxxxxx = DEMOD 1 ERROR`
			`xxxx1xxx xxxxxxxx = DEMOD 0 ERROR`
			`xxxxx1xx xxxxxxxx = RESERVED`
			`xxxxxx1x xxxxxxxx = TIMING CARD ERROR`
			`xxxxxxx1 xxxxxxxx = RESERVED`

29-32	15,16	Speed of Sound	Contains either manual or calculated speed of sound information (EC-command). Scaling: LSD = 1 meter per second; Range = 1400 to 1600 m/s

Continued next page

Table 29: Variable Leader Data Format (continued)

Hex Digit	Binary Byte	Field	Description
33-36	17,18	Depth of Transducer	Contains the depth of the transducer below the water surface (ED-command). This value may be a manual setting or a reading from a depth sensor. Scaling: LSD = 1 decimeter; Range = 1 to 9999 decimeters
37-40	19,20	Heading	Contains the DVS heading angle (EH-command). This value may be a manual setting or a reading from a heading sensor. Scaling: LSD = 0.01 degree; Range = 000.00 to 359.99 degrees
41-44	21,22	Pitch (Tilt 1)	Contains the DVS pitch angle (EP-command). This value may be a manual setting or a reading from a tilt sensor. Positive values mean that Beam #3 is spatially higher than Beam #4. Scaling: LSD = 0.01 degree; Range = -20.00 to +20.00 degrees
45-48	23,24	Roll (Tilt 2)	Contains the DVS roll angle (ER-command). This value may be a manual setting or a reading from a tilt sensor. For up-facing DVSs, positive values mean that Beam #2 is spatially higher than Beam #1. For down-facing DVSs, positive values mean that Beam #1 is spatially higher than Beam #2. Scaling: LSD = 0.01 degree; Range = -20.00 to +20.00 degrees
49-52	25,26	Salinity	Contains the salinity value of the water at the transducer head (ES-command). This value may be a manual setting or a reading from a conductivity sensor. Scaling: LSD = 1 part per thousand; Range = 0 to 40 ppt
53-56	27,28	Temperature	Contains the temperature of the water at the transducer head (ET-command). This value may be a manual setting or a reading from a temperature sensor. Scaling: LSD = 0.01 degree; Range = -5.00 to +40.00 degrees
57,58 59,60 61,62	29 30 31	MPT minutes MPT seconds MPT hundredths	This field contains the Minimum Pre-Ping Wait Time between ping groups in the ensemble.
63,64 65,66 67,68	32 33 34	Hdg Std Dev Pitch Std Dev Roll Std Dev	These fields contain the standard deviation (accuracy) of the heading and tilt angles from the gyrocompass/pendulums. Scaling (Heading): LSD = 1°; Range = 0 to 180° Scaling (Tilts): LSD = 0.1°; Range = 0.0 to 20.0°

Table 29: Variable Leader Data Format (continued)

Hex Digit	Binary Byte	Field	Description

69-70
71-72
73-74
75-76
77-78
79-80
81-82
83-84
	35
	36
	37
	38
	39
	40
	41
	42
		ADC Channel 0
		ADC Channel 1
		ADC Channel 2
		ADC Channel 3
		ADC Channel 4
		ADC Channel 5
		ADC Channel 6
		ADC Channel 7
			These fields contain the outputs of the Analog-to-Digital Converter (ADC) located on the DSP board. The ADC sequentially samples one of the eight channels per ping group (the number of ping groups per ensemble is the maximum of the WP). These fields are zeroed at the beginning of the deployment and updated each ensemble at the rate of one channel per ping group. For example, if the ping group size is 5, then:
			`END OF ENSEMBLE No.     CHANNELS UPDATED`
			`Start                   All channels = 0`
			`1                       0, 1, 2, 3, 4`
			`2                       5, 6, 7, 0, 1`
			`3                       2, 3, 4, 5, 6`
			`4                       7, 0, 1, 2, 3`
			↓ ↓
			Here is the description for each channel:
			`CHANNEL  DESCRIPTION`
			`0        XMIT CURRENT`
			`1        XMIT VOLTAGE`
			`2        AMBIENT TEMP`
			`3        PRESSURE (+)`
			`4        PRESSURE (-)`
			`5        ATTITUDE TEMP`
			`6        ATTITUDE`
			`7        CONTAMINATION SENSOR`
			Note that the ADC values may be “noisy” from sample-to-sample, but are useful for detecting long-term trends.

85-86	43	Error Status Word	Contains the long word containing the bit flags for the CY? Command. The ESW is cleared (set to zero) between each ensemble.
			Note that each number above represents one bit set – they may occur in combinations. For example, if the long word value is 0000C000 (hexadecimal), then it indicates that <u>both</u> a cold wake-up (0004000) and an unknown wake-up (00008000) occurred.
			`Low 16 BITS`
			`LSB`
			`BITS 07 06 05 04 03 02 01 00`
			`      x  x  x  x  x  x  x  1  Bus Error exception`
			`      x  x  x  x  x  x  1  x  Address Error exception`
			`      x  x  x  x  x  1  x  x  Illegal Instruction exception`
			`      x  x  x  x  1  x  x  x  Zero Divide exception`
			`      x  x  x  1  x  x  x  x  Emulator exception`
			`      x  x  1  x  x  x  x  x  Unassigned exception`
			`      x  1  x  x  x  x  x  x  Watchdog restart occurred`
			`      1  x  x  x  x  x  x  x  Battery Saver power`

87-88	44		`Low 16 BITS`
			`MSB`
			`BITS 15 14 13 12 11 10 09 08`
			`      x  x  x  x  x  x  x  1  Pinging`
			`      x  x  x  x  x  x  1  x  Not Used`
			`      x  x  x  x  x  1  x  x  Not Used`
			`      x  x  x  x  1  x  x  x  Not Used`
			`      x  x  x  1  x  x  x  x  Not Used`
			`      x  x  1  x  x  x  x  x  Not Used`
			`      x  1  x  x  x  x  x  x  Cold Wakeup occurred`
			`      1  x  x  x  x  x  x  x  Unknown Wakeup occurred`

89-90	45		`High 16 BITS`
			`LSB`
			`BITS 23 22 21 20 19 18 17 16`
			`      x  x  x  x  x  x  x  1  Clock Read error occurred`
			`      x  x  x  x  x  x  1  x  Unexpected alarm`
			`      x  x  x  x  x  1  x  x  Clock jump forward`
			`      x  x  x  x  1  x  x  x  Clock jump backward`
			`      x  x  x  1  x  x  x  x  Not Used`
			`      x  x  1  x  x  x  x  x  Not Used`
			`      x  1  x  x  x  x  x  x  Not Used`
			`      1  x  x  x  x  x  x  x  Not Used`

Table 29: Variable Leader Data Format (continued)

Hex Digit	Binary Byte	Field	Description
91-92	46		High 16 BITS MSB BITS 31 30 29 28 27 26 25 24 x x x x x x x 1 Not Used x x x x x x 1 x Not Used x x x x x 1 x x Not Used x x x x 1 x x x Power Fail (Unrecorded) x x x 1 x x x x Spurious level 4 intr (DSP) x x 1 x x x x x Spurious level 5 intr (UART) x 1 x x x x x x Spurious level 6 intr (CLOCK) 1 x x x x x x x Level 7 interrupt occurred
93-112	47-56	Reserved	Reserved for TRDI use.
113-114	57	Spare	Spare
115-116	58	RTC Century	These fields contain the time from the DVS's Y2K compliant real-time clock (RTC) that the current data ensemble began. The TT-command (Set Real-Time Clock) initially sets the clock. The DVS does account for leap years.
117-118	59	RTC Year	
119-120	60	RTC Month	
121-122	61	RTC Day	
123-124	62	RTC Hour	
125-126	63	RTC Minute	
127-128	64	RTC Seconds	
129-130	65	RTC Hundredths	

11.4 Velocity Data Format

BIT POSITIONS

BYTE	7/S	6	5	4	3	2	1	0	
1	VELOCITY ID								LSB 00h
2									MSB 01h
3	DEPTH CELL #1, VELOCITY 1								LSB
4									MSB
5	DEPTH CELL #1, VELOCITY 2								LSB
6									MSB
7	DEPTH CELL #1, VELOCITY 3								LSB
8									MSB
9	DEPTH CELL #1, VELOCITY 4								LSB
10									MSB
11	DEPTH CELL #2, VELOCITY 1								LSB
12									MSB
13	DEPTH CELL #2, VELOCITY 2								LSB
14									MSB
15	DEPTH CELL #2, VELOCITY 3								LSB
16									MSB
17	DEPTH CELL #2, VELOCITY 4								LSB
18									MSB
↓	(SEQUENCE CONTINUES FOR UP TO 5 CELLS)								↓
1019	DEPTH CELL #5, VELOCITY 1								LSB
1020									MSB
1021	DEPTH CELL #5, VELOCITY 2								LSB
1022									MSB
1023	DEPTH CELL #5, VELOCITY 3								LSB
1024									MSB
1025	DEPTH CELL #5, VELOCITY 4								LSB
1026									MSB

See Table 30 for description of fields

Figure 58. Velocity Data Format

NOTE. The number of depth cells is set by the WN-command.

The DVS packs velocity data for each depth cell of each beam into a two-byte, two's-complement integer [-32768, 32767] with the LSB sent first. The DVS scales velocity data in millimeters per second (mm/s). A value of –32768 (8000h) indicates bad velocity values.

All velocities are relative based on a stationary instrument. To obtain absolute velocities, algebraically remove the velocity of the instrument. For example,

```
RELATIVE WATER CURRENT VELOCITY:    EAST 650 mm/s
INSTRUMENT VELOCITY            : (-) EAST 600 mm/s
ABSOLUTE WATER VELOCITY        :     EAST  50 mm/s
```

The setting of the EX-command (Coordinate Transformation) determines how the DVS references the velocity data as shown below.

EX-CMD	COORD SYS	VEL 1	VEL 2	VEL 3	VEL 4
xxx00xxx	BEAM	TO BEAM 1	TO BEAM 2	TO BEAM 3	TO BEAM 4
xxx01xxx	INST	Bm1-Bm2	Bm4-Bm3	TO XDUCER	ERR VEL
xxx10xxx	SHIP	PRT-STBD	AFT-FWD	TO SURFACE	ERR VEL
xxx11xxx	EARTH	TO EAST	TO NORTH	TO SURFACE	ERR VEL

POSITIVE VALUES INDICATE WATER MOVEMENT

Table 30: Velocity Data Format

Hex Digit	Binary Byte	Field	Description
1-4	1,2	Velocity ID	Stores the velocity data identification word (00 01h).
5-8	3,4	Depth Cell 1, Velocity 1	Stores velocity data for depth cell #1, velocity 1. See above.
9-12	5,6	Depth Cell 1, Velocity 2	Stores velocity data for depth cell #1, velocity 2. See above.
13-16	7,8	Depth Cell 1, Velocity 3	Stores velocity data for depth cell #1, velocity 3. See above.
17-20	9,10	Depth Cell 1, Velocity 4	Stores velocity data for depth cell #1, velocity 4. See above.
21-2052	11-1026	Cells 2 – 5 (if used)	These fields store the velocity data for depth cells 2 through 5 (depending on the setting of the WN-command). These fields follow the same format as listed above for depth cell 1.

11.5 Correlation Magnitude, Echo Intensity, and Percent-Good Data Format

BIT POSITIONS

BYTE	7/S	6	5	4	3	2	1	0	
1	ID CODE								LSB
2									MSB
3	DEPTH CELL #1, FIELD #1								
4	DEPTH CELL #1, FIELD #2								
5	DEPTH CELL #1, FIELD #3								
6	DEPTH CELL #1, FIELD #4								
7	DEPTH CELL #2, FIELD #1								
8	DEPTH CELL #2, FIELD #2								
9	DEPTH CELL #2, FIELD #3								
10	DEPTH CELL #2, FIELD #4								
↓	(SEQUENCE CONTINUES FOR UP TO 5 BINS)								↓
511	DEPTH CELL #5, FIELD #1								
512	DEPTH CELL #5, FIELD #2								
513	DEPTH CELL #5, FIELD #3								
514	DEPTH CELL #5, FIELD #4								

See Table 31 through Table 33 for a description of the fields.

Figure 59. Binary Correlation Magnitude, Echo Intensity, and Percent-Good Data Format

NOTE. The number of depth cells is set by the WN-command.

Correlation magnitude data give the magnitude of the normalized echo autocorrelation at the lag used for estimating the Doppler phase change. The DVS represents this magnitude by a linear scale between 0 and 255, where 255 is perfect correlation (i.e., a solid target). A value of zero indicates bad correlation values.

Table 31: Correlation Magnitude Data Format

Hex Digit	Binary Byte	Field	Description
1-4	1,2	ID Code	Stores the correlation magnitude data identification word (00 02h).
5,6	3	Depth Cell 1, Field 1	Stores correlation magnitude data for depth cell #1, beam #1. See above.
7,8	4	Depth Cell 1, Field 2	Stores correlation magnitude data for depth cell #1, beam #2. See above.
9,10	5	Depth Cell 1, Field 3	Stores correlation magnitude data for depth cell #1, beam #3. See above.
11,12	6	Depth Cell 1, Field 4	Stores correlation magnitude data for depth cell #1, beam #4. See above.
13 – 1028	7 – 514	Cells 2 – 5 (if used)	These fields store correlation magnitude data for depth cells 2 through 5 (depending on the WN-command) for all four beams. These fields follow the same format as listed above for depth cell 1.

The echo intensity scale factor is about 0.45 dB per DVS count. The DVS does not directly check for the validity of echo intensity data.

Table 32: Echo Intensity Data Format

Hex Digit	Binary Byte	Field	Description
1 – 4	1,2	ID Code	Stores the echo intensity data identification word (00 03h).
5,6	3	Depth Cell 1, Field 1	Stores echo intensity data for depth cell #1, beam #1. See above.
7,8	4	Depth Cell 1, Field 2	Stores echo intensity data for depth cell #1, beam #2. See above.
9,10	5	Depth Cell 1, Field 3	Stores echo intensity data for depth cell #1, beam #3. See above.
11,12	6	Depth Cell 1, Field 4	Stores echo intensity data for depth cell #1, beam #4. See above.
13 – 1028	7 – 514	Cells 2 – 5 (if used)	These fields store echo intensity data for depth cells 2 through 5 (depending on the WN-command) for all four beams. These fields follow the same format as listed above for depth cell 1.

The percent-good data field is a data-quality indicator that reports the percentage (0 to 100) of good data collected for each depth cell of the velocity profile. The setting of the EX-command (Coordinate Transformation) determines how the DVS references percent-good data as shown below.

EX-Command	Coord. Sys	Velocity 1	Velocity 2	Velocity 3	Velocity 4
			Percentage Of Good Pings For:		
		Beam 1	BEAM 2	BEAM 3	BEAM 4
xxx00xxx	Beam		**Percentage Of:**		
xxx01xxx	Inst	3-Beam Transformations (note 1)	Transformations Rejected (note 2)	More Than One Beam Bad In Bin	4-Beam Transformations
xxx10xxx	Ship				
xxx11xxx	Earth				

1. Because profile data did not exceed correlation threshold.
2. Because the error velocity threshold (WE) was exceeded.

At the start of the velocity profile, the backscatter echo strength is typically high on all four beams. Under this condition, the DVS uses all four beams to calculate the orthogonal and error velocities. As the echo returns from far away depth cells, echo intensity decreases. At some point, the echo will be weak enough on any given beam to cause the DVS to reject some of its depth cell data. This causes the DVS to calculate velocities with three beams instead of four beams. When the DVS does 3-beam solutions, it stops calculating the error velocity because it needs four beams to do this. At some further depth cell, the DVS rejects all cell data because of the weak echo. As an example, let us assume depth cell 5 has returned the following percent-good data.

```
FIELD #1 = 50, FIELD #2 = 5, FIELD #3 = 0, FIELD #4 = 45
```

If the EX-command was set to collect velocities in BEAM coordinates, the example values show the percentage of pings having good solutions in cell 60 for each beam based on the Low Correlation Threshold. Here, beam 1=50%, beam 2=5%, beam 3=0%, and beam 4=45%. These are not typical nor desired percentages. Typically, you would want all four beams to be about equal and greater than 25%.

On the other hand, if velocities were collected in INSTRUMENT, SHIP, or EARTH coordinates, the example values show:

FIELD 1 – Percentage of good 3-beam solutions – Shows percentage of successful velocity calculations (50%) using 3-beam solutions because the correlation threshold was not exceeded.

FIELD 2 – Percentage of transformations rejected – Shows percent of error velocity (5%) that was less than the WE-command setting. WE has a default of 5000 mm/s. This large WE setting effectively prevents the DVS from rejecting data based on error velocity.

FIELD 3 – Percentage of more than one beam bad in bin – 0% of the velocity data were rejected because not enough beams had good data.

FIELD 4 – Percentage of good 4-beam solutions – 45% of the velocity data collected during the ensemble for depth cell 60 were calculated using four beams.

Table 33: Percent-Good Data Format

Hex Digit	Binary Byte	Field	Description
1-4	1,2	ID Code	Stores the percent-good data identification word (00 04h).
5,6	3	Depth cell 1, Field 1	Stores percent-good data for depth cell #1, field 1. See above.
7,8	4	Depth cell 1, Field 2	Stores percent-good data for depth cell #1, field 2. See above.
9,10	5	Depth cell 1, Field 3	Stores percent-good data for depth cell #1, field 3. See above.
11,12	6	Depth cell 1, Field 4	Stores percent-good data for depth cell #1, field 4. See above.
13-1028	7-514	Depth cell 2 – 5 (if used)	These fields store percent-good data for depth cells 2 through 5 (depending on the WN-command), following the same format as listed above for depth cell 1.

11.6 Binary Reserved BIT Data Format

BIT POSITIONS

BYTE	7	6	5	4	3	2	1	0	
1	RESERVED FOR TRDI USE								LSB
2									MSB

Figure 60. Binary Reserved BIT Data Format

NOTE. The data is always output in this format. See Table 34 for a description of the fields.

Table 34: Reserved for TRDI Format

Hex Digit	Binary Byte	Field	Description
1-4	1,2	Reserved for TRDI's use	This field is for TRDI (internal use only).

11.7 Binary Checksum Data Format

BIT POSITIONS

BYTE	7	6	5	4	3	2	1	0	
1	CHECKSUM DATA								LSB
2									MSB

Figure 61. Binary Checksum Data Format

NOTE. The data is always output in this format. See Table 35 for a description of the fields.

Table 35: Checksum Data Format

Hex Digit	Binary Byte	Field	Description
1-4	1,2	Checksum Data	This field contains a modulo 65536 checksum. The DVS computes the checksum by summing all the bytes in the output buffer excluding the checksum.

12 How to Decode a DVS Ensemble

Use the following information to help you write your own software.

12.1 Rules for the BroadBand Data Format PD0

a. All data types (i.e. fixed leader, variable leader, velocity, echo intensity, correlation, percent good, etc.) will be given a specific and unique ID number. The table below shows some of the most common IDs.

Table 36: Common Data Format IDs

ID	Description
0x7F7F	Header
0x0000	Fixed Leader
0x0080	Variable Leader
0x0100	Velocity Profile Data
0x0200	Correlation Profile Data
0x0300	Echo Intensity Profile Data
0x0400	Percent Good Profile Data
0x0500	Status Profile Data

b. Once a data type has been given an ID number and the format of that data has been published we consider the format for each field has being fixed. Fixed refers to units used for a given field, the number of bytes in a given field, and the order in which the fields appear within the data type. Fixed does not refer to the total number of bytes in the data type - see Rule “c”.

c. Data may be added to an existing data type only by adding the bytes to the end of the data format. As an example, the variable leader data contains information on ensemble number, time, heading, pitch, roll, temperature, pressure, etc. The format for the bytes 1-53 are now specified by changes added in support to the DVS. If additional sensor data is to be added to the variable leader data then it must be added to the end of the data string (bytes 54-x as an example).

d. The order of data types in an ensemble is not fixed. That is there is no guarantee that velocity data will always be output before correlation data.

e. The header data will include the number of data types in the files and the offset to each ID number for each data type.

f. The total number of the bytes in an ensemble minus the 2-byte checksum will be included in the header.

12.2 Recommended Data Decoding Sequence for BroadBand Data Format PD0

a. Locate the header data by locating the header ID number (in the case of PD0 profile data that will be 7F7F).

b. Confirm that you have the correct header ID by:

   1. Locating the total number of bytes (located in the header data) in the ensemble. This will be your offset to the next ensemble.
   2. Calculate the checksum of total number of bytes in the ensemble excluding the checksum. The checksum is calculated by adding the value of each byte. The 2-byte least significant digits that you calculate will be the checksum.
   3. Read the 2-byte checksum word at the end of the ensemble, located by using the checksum offset in the header (determined in step "b-1") and compare this checksum word to the value calculated in step "b-2".
   4. If the checksums match then you have a valid ensemble. If the checksums do not match then you do not have a valid ensemble and you need to go back to step "a" and search for the next header ID number occurrence.

c. Locate the number of data types (located in the header data).

d. Locate the offset to each data type (located in the header data).

e. Locate the data ID type you wish to decode by using the offset to each data type and confirm the data ID number at that offset matches the ID type you are looking for.

f. Once the proper ID type has been located, use the DVS Technical Manual for the DVS you are using to understand what each byte represents in that particular data type.

12.3 Pseudo-Code for Decoding PD0 Ensemble Data

The following examples show the pseudo-code for decoding PD0 ensemble data.

g. Define structures, which contain all fields in all data types of the PD0 format.

   1. typedef struct { <lists of types and fields> } FixedLeader.
   2. typedef struct { <lists of types and fields> } VariableLeader.
   3. typedef struct { <lists of types and fields> } VelocityType
   4. and so on for every available type.

h. Clear checksum.
i. Look for PD0 ID 0x7F. Add to checksum.
j. Is next byte a 0x7F? Add to checksum.
k. If no, return to step “b”.
l. Else, read next two bytes to determine offset to checksum. Add two bytes to checksum.
m. Read in X more bytes, where X = offset to checksum - 4. Adding all bytes to checksum.
n. Read in checksum word.
o. Do checksums equal?
p. If no, return to “b”.
q. For each available data type (the header contains the # of data types), go to the offset list in header.
    1. Create a pointer to type short to the data type at an offset in the list.
    2. Check the Type ID.
    3. Create a pointer of appropriate type to that location.
    4. Repeat for all available data types.
r. Work with data.
s. Return to “b” for next ensemble.

NOTES

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