

# DOPPLER VOLUME SAMPLER (DVS) OPERATION MANUAL



P/N 95B-6067-00 (December 2013)

© 2012 Teledyne RD Instruments, Inc. All rights reserved.

Information included herein is controlled by the Export Administration Regulations (EAR) and may require an export license, license exception or other approval from the appropriate U.S. Government agency before being exported from the United States or provided to any foreign person. Diversion contrary to U.S. law is prohibited.



## TABLE OF CONTENTS

<b>CHAPTER 1 - AT A GLANCE</b> .....	<b>1</b>
Conventions Used in this Manual.....	2
DVS Features.....	2
Available Options.....	5
Computer Considerations.....	7
Power Considerations.....	7
Unpacking and Inventory.....	8
<b>CHAPTER 2 - INSTALLATION</b> .....	<b>9</b>
Connecting the I/O Cable.....	10
Connecting the Mooring Line Clamps.....	11
Installing the Optional Vane.....	13
Installing the Optional CTD.....	14
Set Up the DVS.....	15
RS-232 or RS-422 Setup.....	16
Inductive Modem Setup.....	17
<b>CHAPTER 3 - MAINTENANCE</b> .....	<b>21</b>
Parts Location Drawings.....	22
Visual Inspection of the DVS.....	30
Spare Parts.....	32
DVS Disassembly and Assembly.....	33
Tension Cord.....	33
750 Meter DVS Disassembly.....	34
Removing the 750 Meter End-Cap.....	34
Removing the 750 meter Transducer Head Assembly.....	36
750 Meter DVS Assembly.....	37
Installing the 750 Meter Transducer Head.....	37
Installing the 750 Meter End-Cap.....	38
6000 Meter DVS Disassembly.....	40
Removing the 6000 Meter End-Cap.....	40
Removing the 6000 Meter Transducer Head Assembly.....	43
6000 Meter DVS Assembly.....	44
Installing the 6000 Meter Transducer Head.....	44
Installing the 6000 Meter End-Cap.....	46
Replacing the DVS Battery Pack.....	49
Switching to the DVS Lithium Battery.....	49
Lithium Battery Upgrade Kit.....	50
Compass Calibration.....	52
Compass Background.....	52
Compass Calibration Procedure.....	53
Periodic Maintenance.....	56
O-Ring Inspection and Replacement.....	56
Replacing the Desiccant Bags.....	57
Prevention of Biofouling.....	58
Antifouling Paints.....	59
Applying Antifouling Paints.....	59
Removing Biofouling.....	60
Cleaning the Thermistor.....	60
Cleaning the Pressure Sensor Port.....	61
Inspecting the Zinc Anodes.....	62
Zinc Anode Inspection.....	62
Zinc Anode Electrical Continuity Check.....	62
Zinc Anode Replacement.....	63

Repairing the Protective Coating Paint .....	63
Replacing Boards in the DVS .....	65
Replacing the PIO, DSP, Personality Module Boards .....	65
Remove DSP, PIO, and Personality Module Boards .....	65
Installing a New DSP, PIO, and Personality Module Board .....	67
Replacing the End Cap Interface Board .....	69
Removing the End-Cap Interface Board .....	69
Installing the New End-Cap Interface Board .....	70
Installing the Pressure Sensor Upgrade .....	71
<b>CHAPTER 4 - TESTING THE DVS .....</b>	<b>73</b>
Running the DVS Built-In Tests .....	74
Short Deployment Test .....	76
Configuring Newly Installed Boards .....	81
Test Scripts .....	82
Script File – DVS with TRDI Temperature Sensor .....	83
Script File – DVS with Sea-Bird Temperature Sensor .....	84
<b>CHAPTER 5 - TROUBLESHOOTING THE DVS .....</b>	<b>85</b>
Equipment Required .....	86
Basic Steps in Troubleshooting .....	87
Troubleshooting the DVS .....	87
Troubleshooting Safety .....	88
Troubleshooting a Communication Failure .....	89
Incorrect Wakeup Message .....	89
No Wakeup Message .....	89
Check the Power .....	89
Check the I/O Cable .....	90
DVS Checks .....	90
Verifying Modem Communications .....	90
Verify Communication with Surface IMM .....	91
Verify Communication with DVS IMM .....	91
Verify Communication with DVS Device .....	92
Surface IMM Settings .....	93
DVS IMM Settings .....	94
Troubleshooting a Built-In Test Failure .....	96
Identify the DVS .....	96
Built-in Tests Failure .....	96
Troubleshooting Data Problems .....	96
Provide DVS Set-up .....	96
Describe the Deployment and Environment .....	97
Provide Raw Data .....	97
DVS Cables .....	97
System Overview .....	98
Operating Modes .....	98
Command Mode .....	98
Autonomous Mode .....	98
Overview of Normal DVS Operation .....	99
Functional Description of Operation .....	99
<b>CHAPTER 6 - RETURNING SYSTEMS TO TRDI FOR SERVICE .....</b>	<b>101</b>
Shipping the DVS .....	102
Returning Systems to the TRDI Factory .....	103
Returning Systems to TRDI Europe Factory .....	104
<b>CHAPTER 7 - SPECIFICATIONS .....</b>	<b>107</b>
Specifications .....	108
Outline Installation Drawings .....	112

<b>CHAPTER 8 – USING COMMANDS .....</b>	<b>129</b>
Data Communication and Command Format .....	130
Command Input Processing .....	130
Data Output Processing.....	131
Firmware Updates.....	132
Using Direct Commands to Deploy the DVS.....	132
Command Summary.....	134
Command Descriptions .....	136
Miscellaneous Commands .....	136
Break.....	136
Soft Break.....	136
Banner.....	137
OI – Install Feature.....	137
OL – Display Feature List .....	137
Control System Commands.....	138
Available Control System Commands .....	138
Control System Command Descriptions.....	138
CA – Communication Timeout .....	138
CB - Serial Port Control .....	139
CF - Flow Control.....	140
CK - Keep Parameters .....	141
CL – Sleep Enable .....	141
CO – Collect and Output a Ping.....	141
CR – Restore Command Defaults .....	142
CS – Start Pinging .....	142
CState – Status.....	143
CStop – Stop Pinging .....	143
CT – Turnkey Mode .....	143
CV – Output Average Ensemble.....	143
CW – Output the Last Stored Ensemble.....	144
CZ – Put DVS to Sleep.....	144
Environmental Commands.....	145
Available Environmental Commands .....	145
Environmental Command Descriptions.....	145
EA – Heading Alignment .....	145
EB - Heading Bias .....	145
EC - Speed of Sound.....	146
ED - Depth of Transducer.....	146
EH - Heading .....	147
EP - Pitch (Tilt 1).....	147
ER - Roll (Tilt 2).....	147
ES – Salinity .....	148
ET - Temperature .....	148
EX – Coordinate Transformation.....	148
EZ - Sensor Source.....	150
Recorder Commands.....	152
Available Recorder Commands .....	152
Recorder Command Descriptions.....	152
ME – Erase Recorder.....	152
MM – Show Memory Usage .....	152
MN – Set File Name .....	153
MQ – Streaming Download.....	153
MR – Set Recorder On/Off.....	153
MY – Y-Modem Download.....	154
Performance and Testing Commands.....	155
Available Performance and Testing Commands.....	155
Performance and Testing Command Descriptions.....	155

PA – Run Go/No-Go Tests .....	155
PC – Built In Tests.....	156
PC0 – Help.....	156
PC2 – Display Sensor Data .....	156
PC3 - Display CTD Sensor Data.....	158
PC4 – Display Voltage Monitor ADC Data .....	158
PC20 – Display Scrolling Sensor Data.....	158
PC30 - Display Scrolling CTD Data .....	158
PC40 – Display Scrolling Voltage Monitor Data .....	159
PD – Data Stream Select .....	159
PF – Display PA Results .....	159
PS – Display System Parameters.....	160
PT - Built-In Tests .....	161
Sensor Commands .....	164
Available Sensor Commands .....	164
Sensor Commands Descriptions.....	164
SA – Compass Commands.....	164
SB – Temperature Commands .....	165
SC – Compass Calibration.....	166
SE – CTD Commands .....	166
SG – Configure Compass Calibration.....	167
SP – Pressure Sensor Commands .....	167
SZ – Sensors .....	169
Timing Commands .....	170
Available Timing Commands .....	170
Timing Command Descriptions .....	170
TE – Time Between Ensembles .....	170
TF – Time of First Ping.....	171
TP – Time Between Pings.....	171
TS – Set System Date and Time.....	172
Water Profiling Commands.....	173
Available Water Profiling Commands.....	173
Water Profiling Command Descriptions.....	173
WB – Bandwidth .....	173
WD – Data Out.....	174
WF – Blanking Distance.....	174
WN – Number of Bins .....	175
WP – Number of Pings .....	175
WS – Bin Size.....	175
<b>CHAPTER 9 – OUTPUT DATA FORMAT.....</b>	<b>177</b>
Hexadecimal-ASCII Output Data .....	178
Binary Output Data Format.....	178
PD22 Output Data Format .....	178
PD20 Output Data Format .....	178
PD20 Header Data Format .....	180
PD20 Scalar Data Format.....	181
PD20 CTD Data Format.....	184
PD20 Array Data Format .....	186
PD20 Checksum Data Format.....	187
PDO Output Data Format .....	188
Header Data Format.....	189
Fixed Leader Data Format .....	191
Variable Leader Data Format .....	196
Velocity Data Format.....	201
Correlation Magnitude, Echo Intensity, and Percent-Good Data Format .....	202
Binary Reserved BIT Data Format.....	205
Binary Checksum Data Format .....	205

How to Decode a DVS Ensemble.....	206
Data Decoding Sequence for Data Format PD20.....	206
Rules for the BroadBand Data Format PDO.....	208
Recommended Data Decoding Sequence for BroadBand Data Format PDO.....	209
<b>APPENDIX A - INDUCTIVE MODEM COMMUNICATIONS AND CONSIDERATIONS.....</b>	<b>211</b>
Equipment needed:.....	213
Connections .....	213
Establish Communications between the SIM and IMM .....	213
Configuring the IMM to communicate with DVS via the older SIM. ....	214
Inductive communication with the DVS.....	214
Using the DVS commands CO, CW, or CV .....	215
Configuring the DVS to use the gdata formalism.....	216
<b>APPENDIX B - NOTICE OF COMPLIANCE .....</b>	<b>217</b>
Date of Manufacture.....	218
Environmental Friendly Use Period (EFUP) .....	218
WEEE.....	218
CE .....	218
Material Disclosure Table.....	219

## LIST OF FIGURES

Figure 1.	DVS Overview .....	4
Figure 2.	DVS 750 Meter Temperature Sensor Configurations .....	5
Figure 3.	DVS End-Cap Configurations .....	6
Figure 4.	End-Cap with Pressure Sensor (750 meter Shown).....	6
Figure 5.	DVS End-Cap I/O Connector Configurations.....	6
Figure 6.	Mounting Hardware .....	12
Figure 7.	DVS Optional Vane Installation .....	13
Figure 8.	DVS Optional CTD Installation .....	14
Figure 9.	DVS RS-232 or RS-422 Setup .....	16
Figure 10.	DVS Inductive Modem Setup.....	17
Figure 11.	DVS Internal Parts Overview (Standard 750 meter System) .....	22
Figure 12.	DVS Internal Parts Overview (6000 meter System) .....	23
Figure 13.	DVS Internal Parts Overview (750 meter System with Pressure Sensor) .....	24
Figure 14.	DVS Internal Parts Overview (6000 meter System with Pressure Sensor) .....	25
Figure 15.	End-cap and Battery Pack Parts Location (Standard 750 meter System) .....	26
Figure 16.	End-cap and Battery Pack Parts Location (6000 meter System).....	27
Figure 17.	End-cap and Battery Pack Parts Location with Pressure Sensor (750 meter System) .....	28
Figure 18.	End-cap and Battery Pack Parts Location with Pressure Sensor (6000 meter System) .....	29
Figure 19.	DVS End-Cap View with Inductive Modem (6000 meter DVS) .....	31
Figure 20.	DVS Transducer with Sea-Bird Thermistor (750 meter DVS).....	31
Figure 21.	Optional Pressure Sensor (750 meter Shown) .....	31
Figure 22.	Tension Cord Overview .....	33
Figure 23.	End Cap Mounting Hardware (Standard 750 Meter System) .....	35
Figure 24.	End Cap Mounting Hardware (with Pressure Sensor) .....	35
Figure 25.	Removing the End-cap .....	36
Figure 26.	Plastic Wedge .....	36
Figure 27.	Removing the Transducer Head from the Housing .....	37
Figure 28.	DVS Assembly – 750 Meter .....	37
Figure 29.	Instruction Label.....	40
Figure 30.	High Pressure End Cap Mounting Hardware .....	41
Figure 31.	High Pressure End Cap Mounting Hardware (with Pressure Sensor) .....	41
Figure 32.	Disconnecting the Strain Relief Cable.....	42

Figure 33.	Transducer Head Mounting Hardware.....	43
Figure 34.	DVS Assembly – 6000 Meter .....	44
Figure 35.	Installing the End-Cap .....	47
Figure 36.	End-Cap Mounting Hardware Replacement.....	48
Figure 37.	High Pressure End-Cap Replacement .....	48
Figure 38.	Compass Calibration.....	54
Figure 39.	Pressure Sensor .....	61
Figure 40.	DVS Phase I Electronic Chassis (750 meter system shown).....	66
Figure 41.	DVS Phase II Electronic Chassis (750 meter system shown).....	66
Figure 42.	Electronics Chassis Cables .....	68
Figure 43.	End-Cap Interface Board (Phase I DVS) .....	69
Figure 44.	End-Cap Interface Board (Phase II DVS) .....	70
Figure 45.	Pressure Sensor Assembly (750 meter DVS) .....	71
Figure 46.	IMM Surface Inductive Modem TRDI Field Test Box .....	74
Figure 47.	Test Cable Wiring (73B-6023-005) .....	97
Figure 48.	Sea-Bird SBE 37-SMP CTD Cable (73B-2014-00).....	98
Figure 49.	DVS Block Diagram .....	99
Figure 50.	Outline Installation Drawing 96B-6036 Sheet 1 .....	113
Figure 51.	Outline Installation Drawing 96B-6036 Sheet 2 .....	114
Figure 52.	Outline Installation Drawing 96B-6036 Sheet 3 .....	115
Figure 53.	Outline Installation Drawing 96B-6037 .....	116
Figure 54.	Outline Installation Drawing 96B-6038 .....	117
Figure 55.	Outline Installation Drawing 96B-6039 .....	118
Figure 56.	Outline Installation Drawing 96B-6040 Sheet 1 .....	119
Figure 57.	Outline Installation Drawing 96B-6040 Sheet 2 .....	120
Figure 58.	Outline Installation Drawing 96B-6041 .....	121
Figure 59.	Outline Installation Drawing 96B-6042 Sheet 1 .....	122
Figure 60.	Outline Installation Drawing 96B-6042 Sheet 2 .....	123
Figure 61.	Outline Installation Drawing 96B-6042 Sheet 3 .....	124
Figure 62.	Outline Installation Drawing 96B-6052 .....	125
Figure 63.	Outline Installation Drawing 96B-6053 .....	126
Figure 64.	Outline Installation Drawing 96B-6054 .....	127
Figure 65.	Outline Installation Drawing 96B-6055 .....	128
Figure 66.	DVS Coordinate Transformation .....	150
Figure 67.	Pitch, Roll, and Heading.....	156
Figure 68.	PC2 and PC20 Raw Roll.....	157
Figure 69.	PC2 and PC20 Raw Pitch.....	157
Figure 70.	One Ensemble Sample.....	172
Figure 71.	PD20 Standard Output Data Buffer Format .....	179
Figure 72.	PD20 Header Data Format .....	180
Figure 73.	PD20 Scalar Data Format.....	182
Figure 74.	PD20 CTD Data Format.....	184
Figure 75.	PD20 Array Data Format .....	186
Figure 76.	PD20 Checksum Data Format.....	187
Figure 77.	PD0 Standard Output Data Buffer Format .....	188
Figure 78.	Binary Header Data Format.....	189
Figure 79.	Fixed Leader Data Format .....	192
Figure 80.	Variable Leader Data Format .....	197
Figure 81.	Velocity Data Format.....	201
Figure 82.	Binary Correlation Magnitude, Echo Intensity, and Percent-Good Data Format .....	203
Figure 83.	Binary Reserved BIT Data Format.....	205
Figure 84.	Binary Checksum Data Format .....	205
Figure 85.	<i>SBE IMM</i> .....	212
Figure 86.	<i>SBE SIM</i> .....	212

## LIST OF TABLES

Table 1:	Visual Inspection Criteria.....	30
Table 2:	DVS Spare Parts.....	32
Table 3:	Lithium Battery Kit 75BK6042.....	50
Table 4:	List of Least Replaceable Assemblies.....	86
Table 5:	Required Test Equipment.....	86
Table 6:	Physical Specifications.....	108
Table 7:	Power Specifications.....	108
Table 8:	Environmental Specifications.....	109
Table 9:	Interface Specifications.....	109
Table 10:	Velocity Specifications.....	110
Table 11:	Echo Intensity Specifications.....	110
Table 12:	Sensor Specifications.....	110
Table 13:	Outline Installation Drawings.....	112
Table 14:	DVS Minimum Required Commands for Deployments.....	132
Table 15:	DVS Input Command Summary.....	134
Table 16:	DVS Factory Defaults.....	135
Table 17:	Serial Port Control.....	139
Table 18:	Baud Rate.....	139
Table 19:	Flow Control.....	140
Table 20:	Retrieve Parameters.....	142
Table 21:	Coordinate Transformation Processing Flags.....	149
Table 22:	Sensor Source Switch Settings.....	151
Table 23:	Data Stream Selections.....	159
Table 24:	Bandwidth Control.....	173
Table 25:	PD20 Header Data Format.....	180
Table 26:	PD20 Scalar Data Format.....	183
Table 27:	PD20 CTD Data Format.....	185
Table 28:	PD20 Array Data Format.....	187
Table 29:	PD20 Checksum Data Format.....	187
Table 30:	Header Data Format.....	190
Table 31:	Fixed Leader Data Format.....	193
Table 32:	Variable Leader Data Format.....	198
Table 33:	Velocity Data Format.....	202
Table 34:	Correlation Magnitude Data Format.....	203
Table 35:	Echo Intensity Data Format.....	203
Table 36:	Percent-Good Data Format.....	204
Table 37:	Reserved for TRDI Format.....	205
Table 38:	Checksum Data Format.....	205
Table 39:	Common Data Format IDs.....	208
Table 40:	Toxic or Hazardous Substances and Elements Contained in Product.....	219

## REVISION HISTORY

### December 2013

- Corrected TRDI Temperature Sensor specifications Precision from 0.0625 to 0.5 deg. C.
- Corrected TRDI Temperature Sensor specifications Resolution from 0.010 to 0.5 deg. C.
- Corrected the Sea-Bird Temperature Sensor specifications temperature range from +1 to 35 degrees C to -5 to +35C.
- Added the new PD22 output data format.
- Updated the PT3 output example.
- Updated the EX command to remove bin mapping.
- Corrected input voltage from +9 to 28VDC to +10.5 to 28VDC.
- Corrected the Variable Leader BIT Result word (Binary Bytes 13, 14) in Table 32.
- Added DVS IMM Timeouts to Chapter 5.

### June 2012

- Updated fonts and styles used in manual.
- Updated assembly and disassembly procedures.
- Added instructions for using the 23.4 VDC lithium battery pack.
- Updated parts location drawings.
- Updated outline installation drawings.
- Added drawings for the pressure sensor location, assembly, and maintenance.
- Added the SP command and updated the SZ command for pressure sensor.
- Added corrections for ICN-140, ICN-142, and ICN-145.
- Added instructions from FST-030, 035, and 040.

### December 2011

- Initial release of the manual.

## EXCLUSIONS AND OMISSIONS

- None

# Chapter 1

## AT A GLANCE



In this chapter, you will learn:

- DVS features
- DVS options
- What are the DVS computer and power requirements?
- Unpacking and inventory

# Conventions Used in this Manual

Conventions used in the Doppler Volume Sampler (DVS) Operation Manual have been established to help learn how to use the system quickly and easily.

Menu items are printed in bold: click **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>), press and hold the first key while pressing the second key. Words printed in italics include program names (*Velocity*) and file names (*default.plan*).

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

```
DVS
Teledyne RD Instruments (c) 2012
All rights reserved.
Firmware Version: 41.xx
>
```

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



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



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

## DVS Features

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 the outline drawings in the DVS Operation Manual for dimensions and weights.

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

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

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

***Temperature Sensor*** – The DVS is configured with either the TRDI temperature sensor or the OEM version of the Sea-Bird Electronics SBE38 thermistor. The SBE38 high resolution thermistor provides extremely accurate temperature data to the DVS. A plastic guard protects the sensor.

***End-Cap*** – The End Cap is configured with either an underwater serial connector or the Inductive Modem Module (IMM) and serial connector. DVS units are pre-configured to use RS-232 or RS-422 communications protocols. User must specify RS-232 or RS-422 preference when ordering the DVS.

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

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

**MicroCat CTD (Optional)** – The DVS supports the Sea-Bird SBE 37-SMP CTD instrument. The CTD has its own battery and logs the CTD data in its own flash memory. CTD data is output to the DVS PD20 data format; it is not used in algorithms.



SBE 37-SMP needs to have firmware version 3.h and above installed. Data stored in flash also gets lost if CTD power is removed.

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

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

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



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.

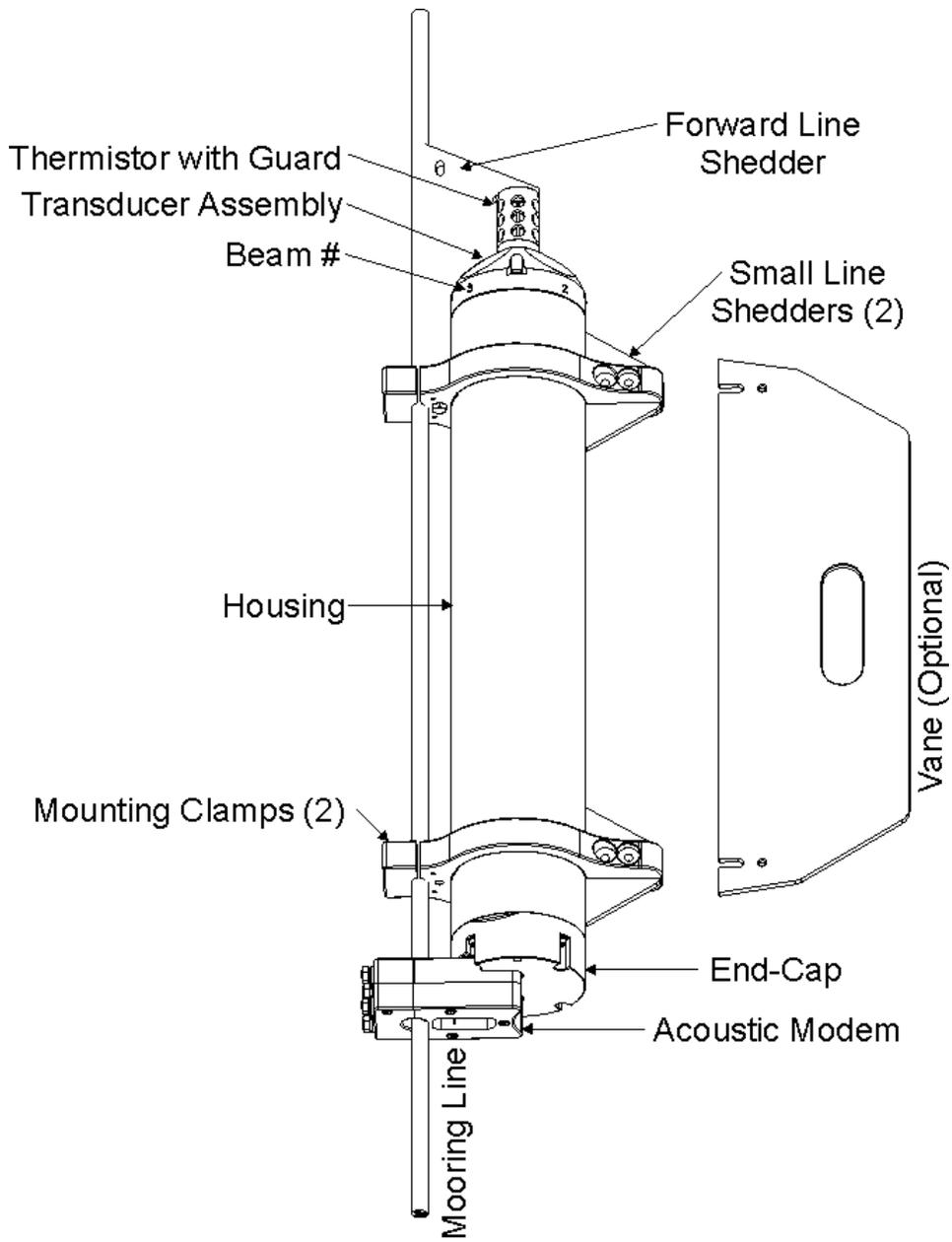


Figure 1. DVS Overview

# Available Options

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

- The DVS can be configured either with the Sea-Bird SBE38 thermistor or with TRDI's temperature sensor. Depending on the type of temperature sensor 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.



If the DVS system includes the Sea-Bird SBE38 thermistor (only available on the 750 m DVS), then it cannot include the CTD.



The temperature sensor is embedded in the head and not visible from the outside on the 6000 meter system.

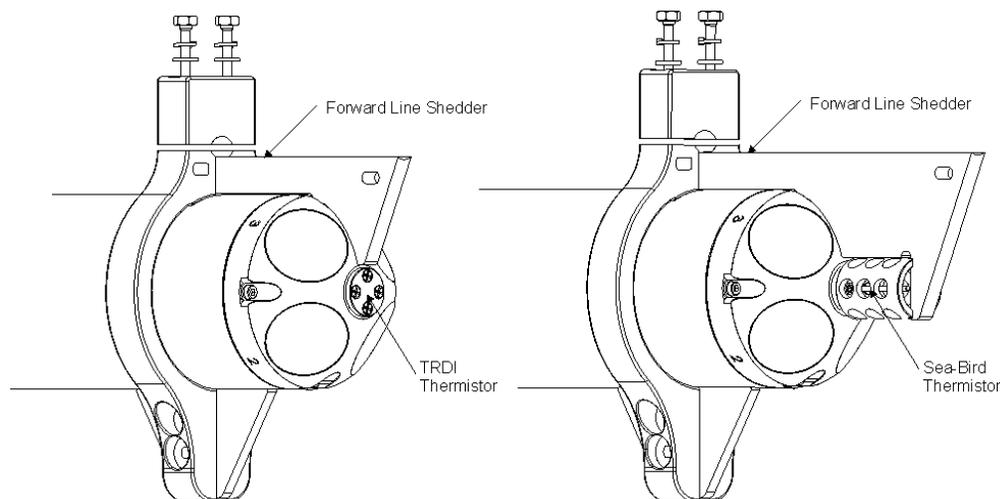
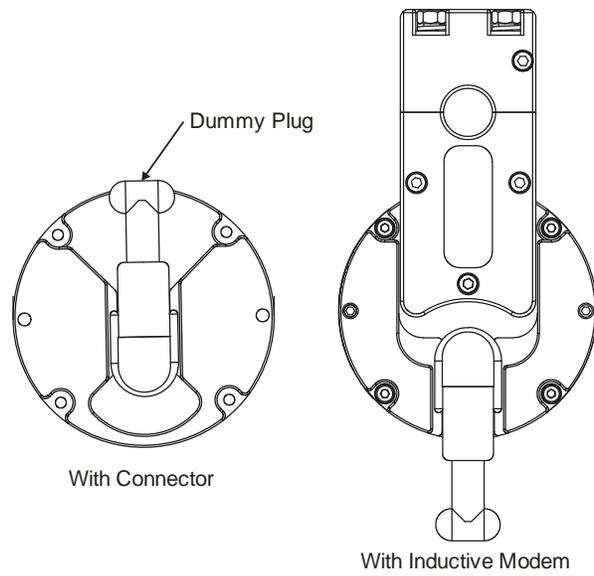


Figure 2. DVS 750 Meter Temperature Sensor Configurations

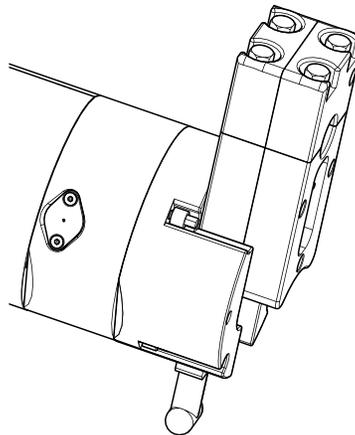
- The End Cap is configured with an underwater connector or both the Inductive Modem Module (IMM) and underwater connector (see Figure 3).
- The DVS is available as a standard 750 meter system or as a high pressure system capable of deployments to 6000 meters.
- The DVS is available with a Sea-Bird SBE 37-SMP CTD instrument. Figure 5 depicts the end cap connector for this option.
- The DVS is pre-configured for RS-232 or RS-422 communication protocols – it is not possible to switch from one protocol to the other in the field.
- An optional vane can be attached opposite to the mooring line to help reduce instrument vibration due to mooring line strumming (see Figure 1).
- The DVS is available with a pressure sensor for the 750 meter and the 6000m depth rated variations (Figure 4).
- DVS units can use either the standard 18 VDC alkaline battery pack or a 23.4 VDC lithium battery pack.



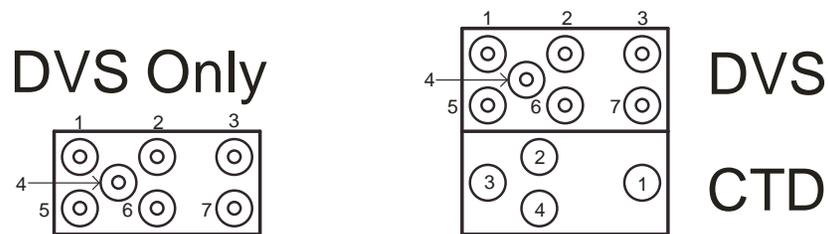
**Figure 3. DVS End-Cap Configurations**



The dummy plug should be installed any time the I/O cable is removed. Use the dummy plug when the DVS is in storage.



**Figure 4. End-Cap with Pressure Sensor (750 meter Shown)**



**Figure 5. DVS End-Cap I/O Connector Configurations**



See [DVS Cables](#) for wiring pin-out diagrams.

# Computer Considerations

TRDI designed the DVS to use a Windows® compatible computer. The DVS software configures the system and data is displayed through TRDI's *WinADCP* program.

Minimum Computer Hardware Requirements:

- Desktop, Laptop, or Netbook computer running Windows XP®, Vista®, or Windows 7®
- Mouse or other pointing device
- CD Drive

# Power Considerations

DVS units require +10.5 to 28 VDC to operate. Use an external power supply to run the DVS when the battery is not connected. The DVS standard alkaline internal battery supplies +18 VDC. The optional lithium battery pack provides 23.4 VDC.

Keep in mind the following about battery packs:

- When the instrument is setup properly, the battery can provide enough energy for a one-year deployment.
- A Standard DVS battery packs hold 12 'D-cell' alkaline batteries with a voltage, when new, of approximately 18 VDC.
- When the capacity of a battery pack is 50% used, the voltage (measured across the battery connector) falls to approximately 14 to 15 volts. However, keep in mind that this voltage is not an accurate predictor of remaining capacity.
- Transmitted power increases or decreases depending on the input voltage (within the voltage range of 10.5 to 28 VDC). A fresh battery provides +18 VDC.
- Batteries spend most of their life at a nominal voltage of +15 VDC.



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

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



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

# Unpacking and Inventory

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.

## **Items included:**

- One (1) Doppler Volume Sampler (DVS)
- Two (2) CDs Containing software and documentation
- One (1) Underwater I/O Cable for RS232 or RS422 communications and external power
- One (1) Shipping Containers
- 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
- Sea-Bird SBE 37-SMP CTD



Mounting hardware and line shedders are available from Teledyne RD Instruments. Please contact your local sales representative for further information regarding configurations and options.

# Chapter 2

## INSTALLATION



In this chapter, you will learn:

- Connecting the I/O cable
- Connecting the mooring line clamps
- Installing the optional vane
- Installing the optional CTD
- How do I set up and communicate with the DVS?

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



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](#)).

## Connecting the I/O Cable

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. TRDI does not recommend removing it for any routine maintenance.



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.



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.



Use light amounts of silicone lubricant (such as 3MTM Silicone Lubricant (Dry Type) ID No: 62-4678-4930-3) on both the male pins and female socket to help seat the cable connectors. Wipe off excessive silicone spray from the metal portions of the pins.  
**Regular lubrication is required: Apply dry type silicone lubricant prior to each connection.**

### Disconnecting the I/O Cable or Dummy Plug

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

1. Release the retaining strap by pulling it over the connector.
2. Grasp the cable close to the end-cap. Your thumb should rest against the edge of the end-cap.
3. 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.

1. Apply a light coat of silicone lubricant to the rubber portion of the end-cap connector pins. This will help seat the connector.
2. 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.
3. Roll the retaining strap over the connector.

# Connecting the Mooring Line Clamps

To connect the DVS to the mooring line:

1. Install the two mounting clamps and line shedders on the DVS housing (see Figure 6).
2. Remove the inductive modem line clamp from the inductive modem.
3. 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.



The diameter of the mooring line must be 9 to 19 mm (0.35 to 0.75 inch). There are two mooring line kits – one for 5 to 8.8 mm cables and another for 9.5 to 19mm cables.

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



There are two types of forward shedders – one for DVS with thermistor (shown in Figure 6) and another one for standard temp sensor.

5. Torque the M6 DVS Mounting Clamp screws and Line Clamp bolts to 14 inch-pound.
6. For the Forward Line Shedder and Small Line Shedders, torque the M6 bolts to 10 inch-pound to secure the fins to the DVS clamps.
7. Torque the M6 Inductive Modem Clamp bolts to 10 inch-pound to secure the inductive modem around the mooring line.

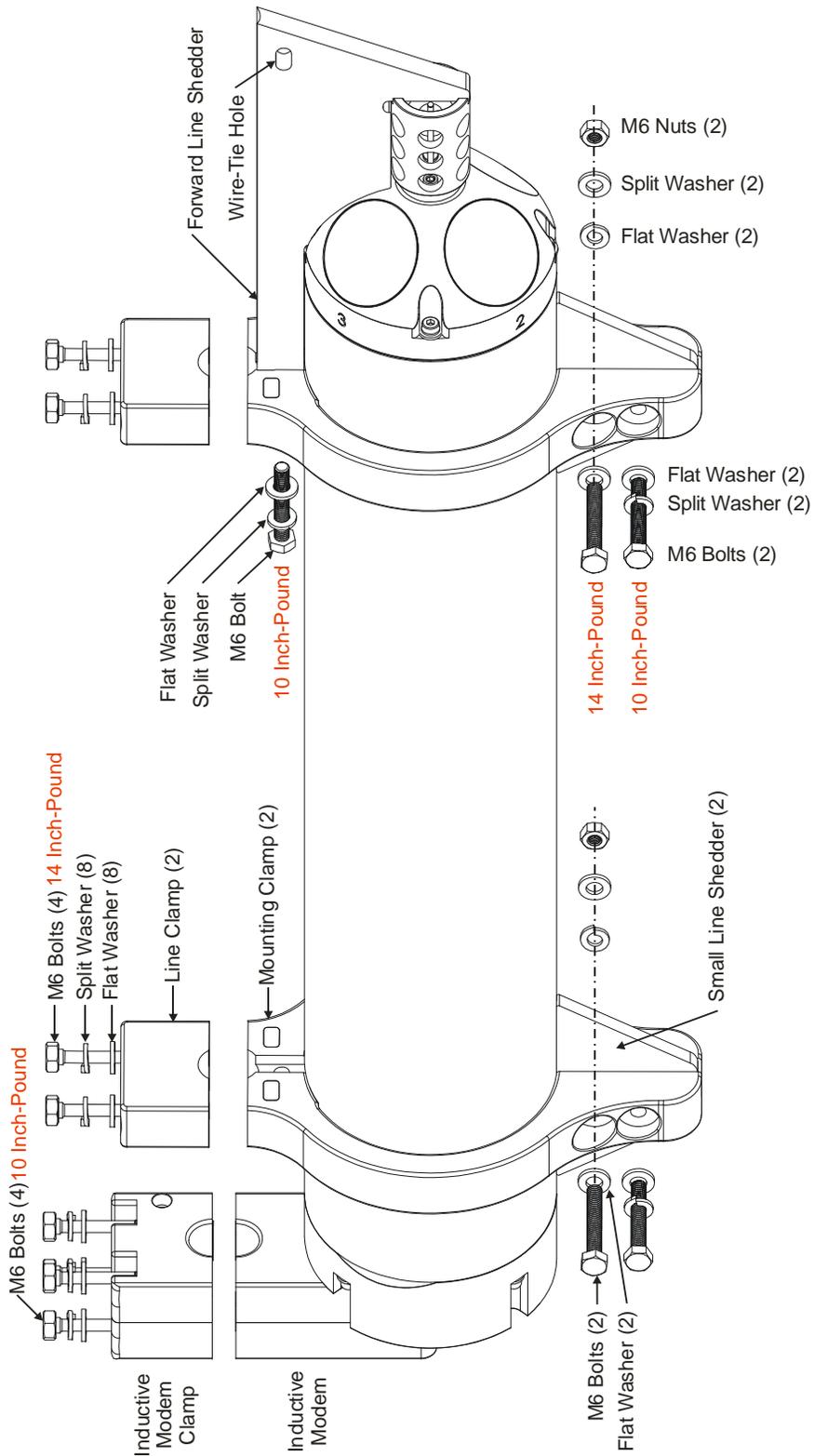


Figure 6. Mounting Hardware

# 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:

1. Remove the two small line shedders.
2. Install the vane using the hardware from the two small line shedders (see Figure 7).
3. Tighten the M6 bolts to 10 inch-pound to secure the vane to the DVS clamps.

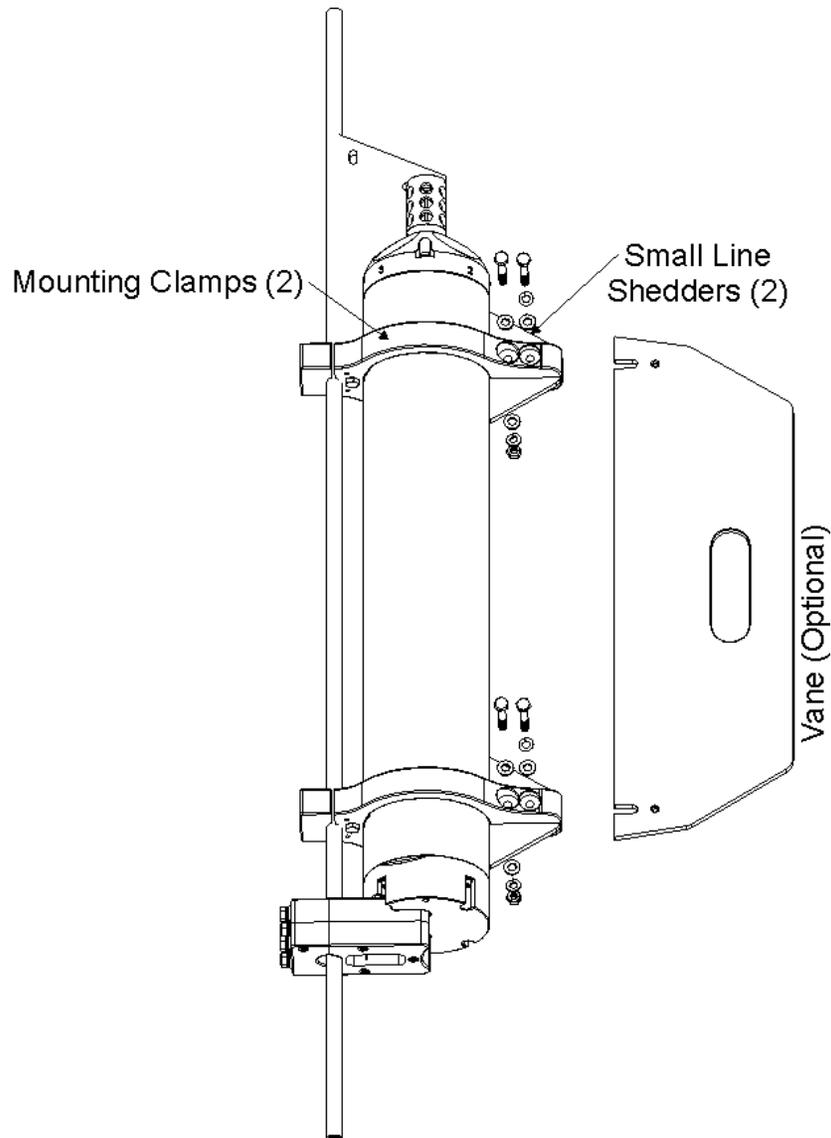


Figure 7. DVS Optional Vane Installation

# Installing the Optional CTD

To connect the optional CTD to the DVS:

1. Remove the small line shedders or optional vane if installed (see Figure 6 and Figure 7). The CTD clamps are installed in their place.
2. Slide the CTD into the clamps.
3. Attach the front and rear CTD clamps to the DVS mounting clamps.
4. Torque the M6 bolts on the CTD clamps to 10 inch-pound to secure the CTD to the DVS clamps.
5. Connect the CTD cable to the DVS.



**Figure 8.** DVS Optional CTD Installation

# Set Up the DVS

Connect the DVS to a power supply and a computer with the *DVS* software installed. On systems equipped with an IMM, most testing and data downloads are done via the end-cap connector and using external power (both to conserve power and because the cable provides faster communication than does the inductive modem).



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



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).



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



The DVS is pre-configured for RS232 or RS422 – it is not possible to switch from one to the other in the field. Your computer's communication port must match the DVS, or use an adapter.

## RS-232 or RS-422 Setup

To connect to the DVS:

1. Remove the dummy plug from the end-cap and connect the I/O cable to the DVS end-cap.
2. Attach the I/O cable to the computer's communication port. The standard communications settings are RS-232, 115200-baud, no parity, 8 data bits and 1 stop bit.
3. Connect the I/O cable red/black banana plugs to an external power supply (+10.5 to 28 VDC).

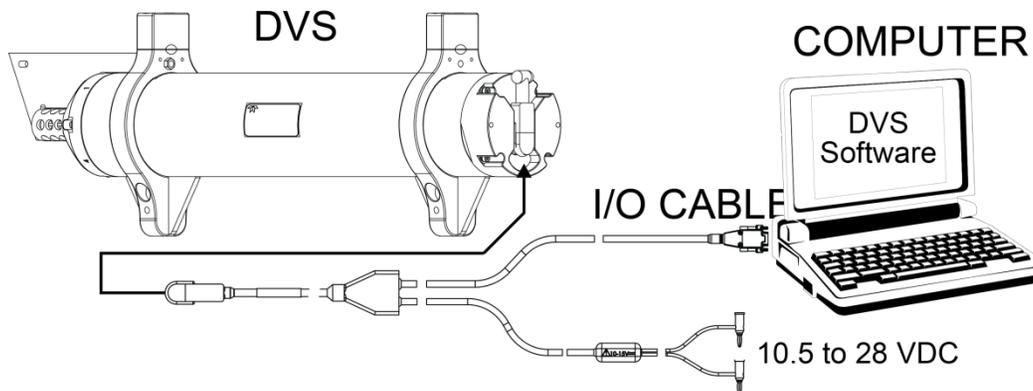
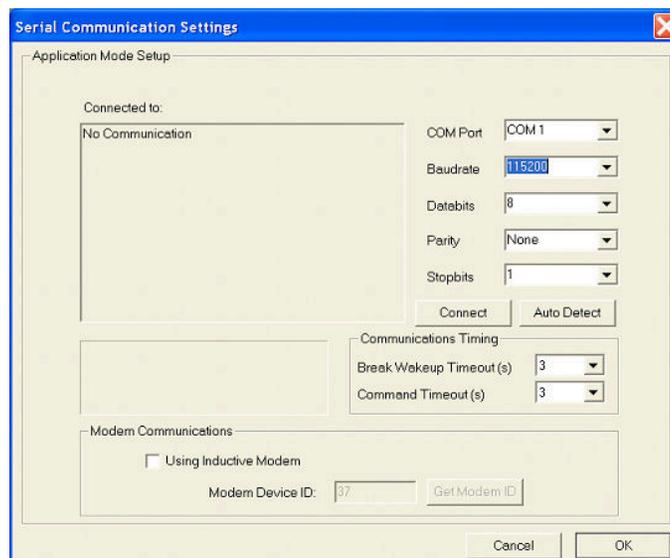


Figure 9. DVS RS-232 or RS-422 Setup

4. Start the *DVS* software.
5. At the **DVS Wizard Startup Options** screen, click **Cancel**.
6. From the **Configure** menu, click **Serial Communications**.
7. Select the COM port, baud rate, parity, and stop bits that the DVS is connected to.

Use Auto Detect if unsure of the setting.



8. Click the **Connect** button. The wakeup message should appear on the deployment log window.

DVS

Teledyne RD Instruments (c) 2010  
All rights reserved.  
Firmware Version: 55.xx

## 9. Click **OK**.



If the DVS does not respond, check the serial port, surface IMM, surface IMM power, wire loop, cables, external power supply, and battery connection. If necessary, refer to the [Troubleshooting](#) section.

## Inductive Modem Setup

To connect the DVS through the inductive modem:

1. Loop a conductor through the DVS inductive modem and the surface inductive modem (not supplied) connected to a computer.
2. Apply power to the DVS from either the battery pack or from an external supply via the I/O cable. If the DVS is sealed for deployment, then power must be supplied from the battery pack.

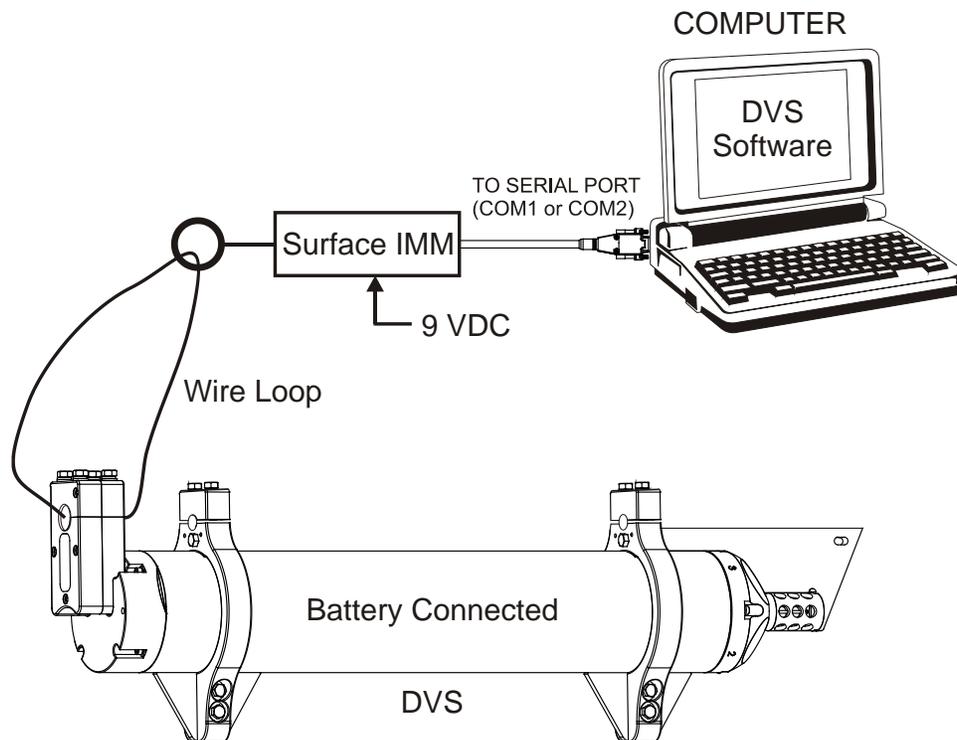


Figure 10. DVS Inductive Modem Setup

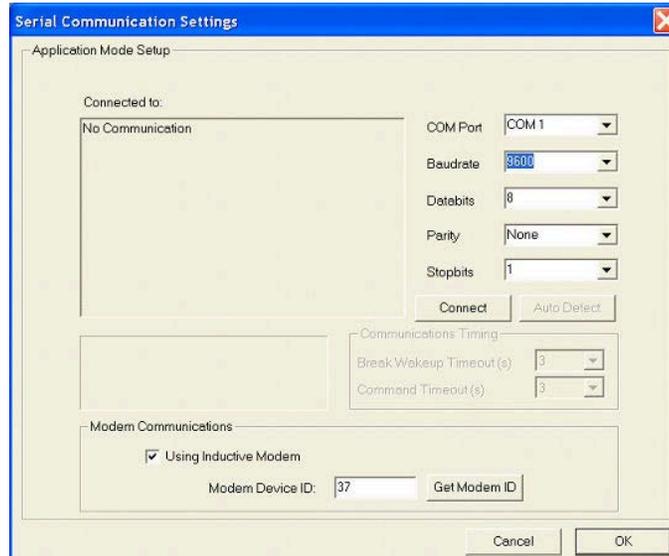


DVS batteries are shipped inside the DVS, but not connected. Connect the battery and seal the DVS before deployment.

To configure the serial connection to the surface IMM:

1. Start the *DVS* software.
2. At the **DVS Wizard Startup Options** screen, click **Cancel**.
3. From the **Configure** menu, click **Serial Communications**.

4. Select the appropriate COM port (i.e. the port that the surface modem is connected to). For the baud rate, select 9600. Serial communications with the IMM's should always be set to 9600 baud. Leave the other settings at their default values.
5. Select the **Using an Inductive Modem** box and click the **Get Modem ID** button.
6. Press the **OK** button to close the **Serial Communication Settings** dialog.

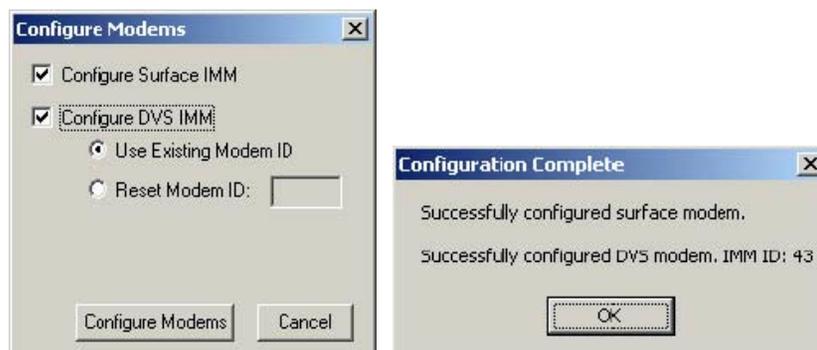


The inductive modems actually communicate with each other at a baud rate of 1200, and do not support communication with the DVS at baud rates above 9600.

7. On the **Configure** menu, select **Modems**. Select which modem(s) to configure (i.e. the Surface IMM connected to the serial port and/or the DVS IMM).
8. If configuring the DVS IMM, you have the option of **Use Existing Modem ID**, or **Reset Modem ID** (from 00 to 99).
9. Press the **Configure Modems** button to start the configuration process. The dialog will update with a status bar and information on the configuration steps being run.

The configuration process will take a few minutes to complete. Once the process is completed, a message box will display that the selected configuration(s) are completed.

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





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

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

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

11. Click the **Connect** button. The wakeup message should appear on the deployment log window.

DVS  
Teledyne RD Instruments (c) 2009  
All rights reserved.  
Firmware Version: 41.xx

12. Click **OK**.



If the DVS does not respond, check the serial port, surface IMM, surface IMM power, wire loop, cables, external power supply, and battery connection. If necessary, refer to the [Troubleshooting](#) section.

If you have verified that all is properly connected and powered, you can also try to establish communication through TRDI *BBTalk*:

1. Connect the Surface Modem Test Box to your computer.
2. Loop a conductor through the DVS inductive modem and the surface inductive modem (not supplied) connected to a computer. Power can be supplied either from the battery pack or from an external supply via the test cable. If the DVS is sealed for deployment, then power must be supplied from the battery pack.
3. Run *BBTalk*.
4. Select 9600 bds.
5. Enable **Echo Characters** option.
6. Switch the surface IMM power switch ON.
7. To confirm the surface modem firmware version, Send GetHD^m^j:

GetHD

```
<HardwareData
DeviceType='SBE90554 IMM' SerialNumber='70001191'>
<Manufacturer>Sea-Bird Electronics, Inc</Manufacturer>
<HardwareVersion>41420H.1</HardwareVersion>
<HardwareVersion>PCB Type 3, 10345B</HardwareVersion>
<MfgDate>2011-02-08</MfgDate>
<FirmwareVersion>IMM Ver 1.09</FirmwareVersion>
<FirmwareDate>Jun 6 2008</FirmwareDate>
<FirmwareLoader>MSP LOADER RS232 57.6K 2007-02-08</FirmwareLoader>
</HardwareData>
```

If you obtained the answer above, this means that the Surface Inductive Modem is working properly and its firmware version is 1.09. If not, then there is a problem with the Surface Inductive Modem. Refer to the Seabird IMM Manual for more troubleshooting information.

8. To confirm the DVS Inductive modem firmware version, Send !01GetHD^m^j:

```
!01GetHD
```

```
<HardwareData  
DeviceType='SBE90554 IMM' SerialNumber='70000142'  
<Manufacturer>Sea-Bird Electronics, Inc</Manufacturer>  
<HardwareVersion>41420D1.1</HardwareVersion>  
<HardwareVersion>PCB Type 2, 10345A</HardwareVersion>  
<MfgDate>20 Feb 07</MfgDate>  
<FirmwareVersion>IMM Ver 1.07</FirmwareVersion>  
<FirmwareDate>Aug 10 2007</FirmwareDate>  
</HardwareData>
```

If you obtained the answer above, this means that the DVS Inductive Modem is working properly and its Firmware Version is 1.07. If not then there is a problem with the DVS Inductive Modem. Refer to [troubleshooting](#) for more information.

# Chapter 3

## MAINTENANCE

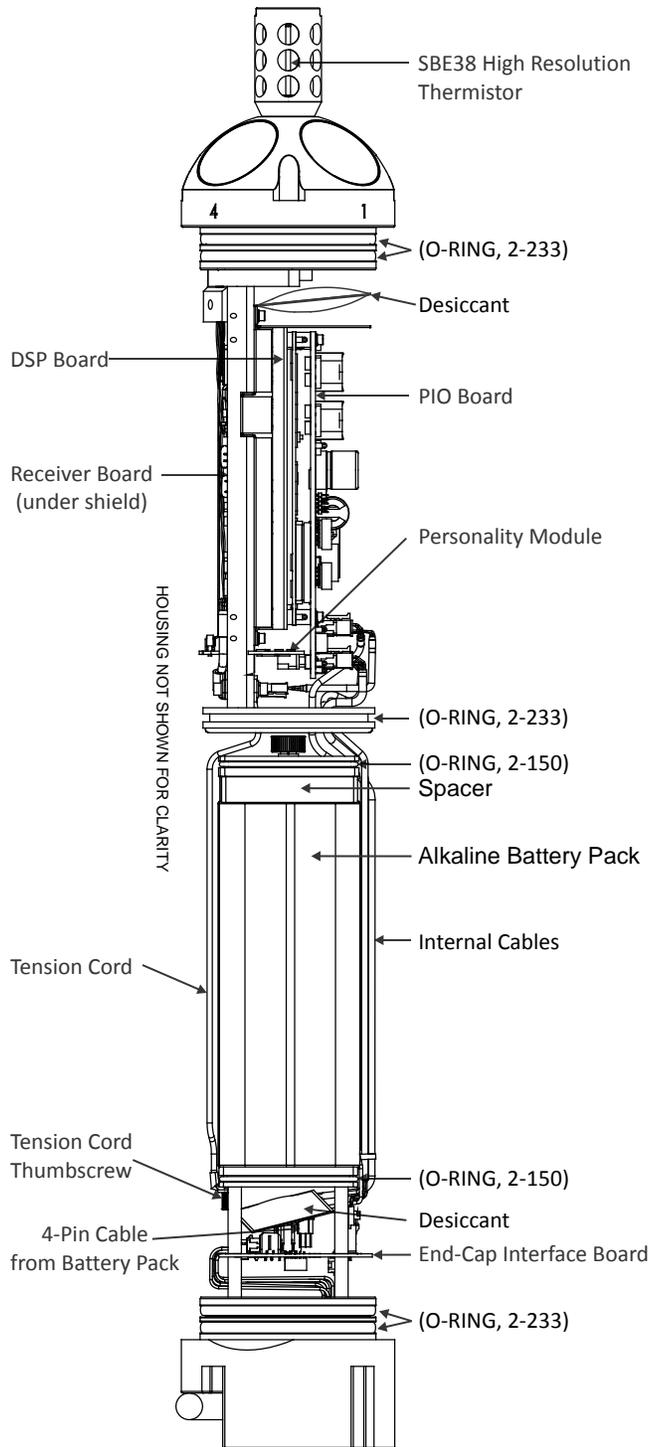


In this chapter, you will learn:

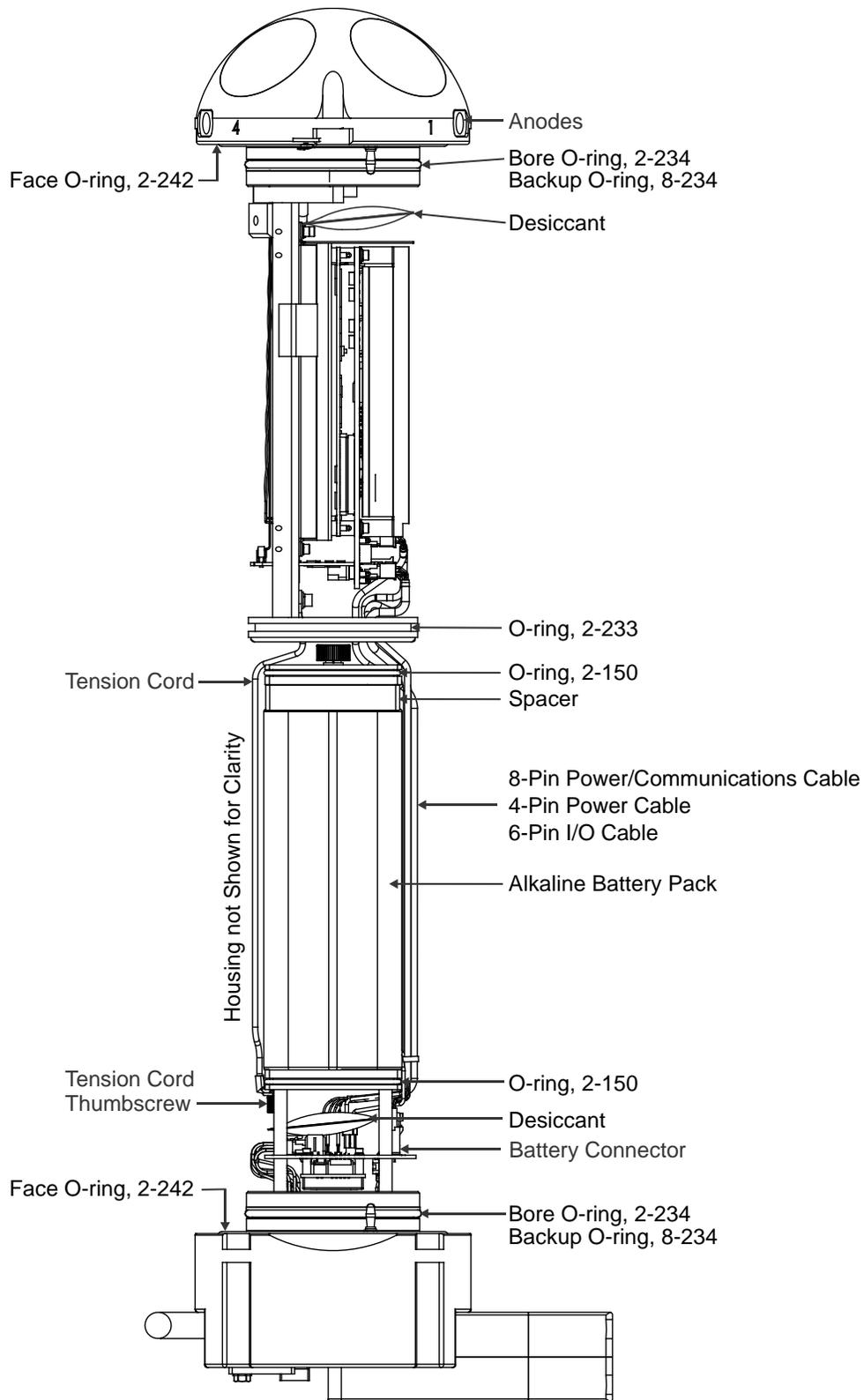
- Where parts are located
- How to spot problems
- How to disassemble and reassemble the DVS
- Periodic maintenance procedures

# Parts Location Drawings

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



**Figure 11. DVS Internal Parts Overview (Standard 750 meter System)**



**Figure 12. DVS Internal Parts Overview (6000 meter System)**

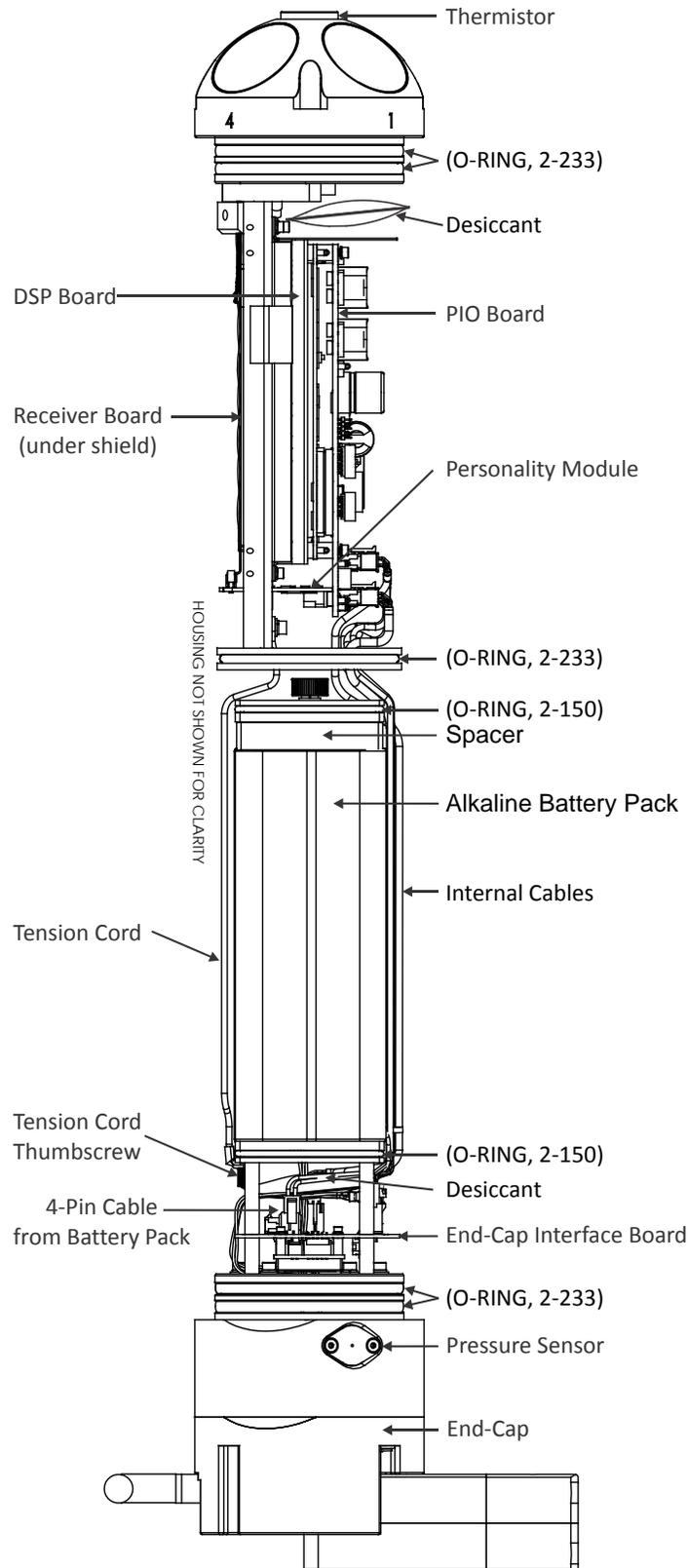


Figure 13. DVS Internal Parts Overview (750 meter System with Pressure Sensor)

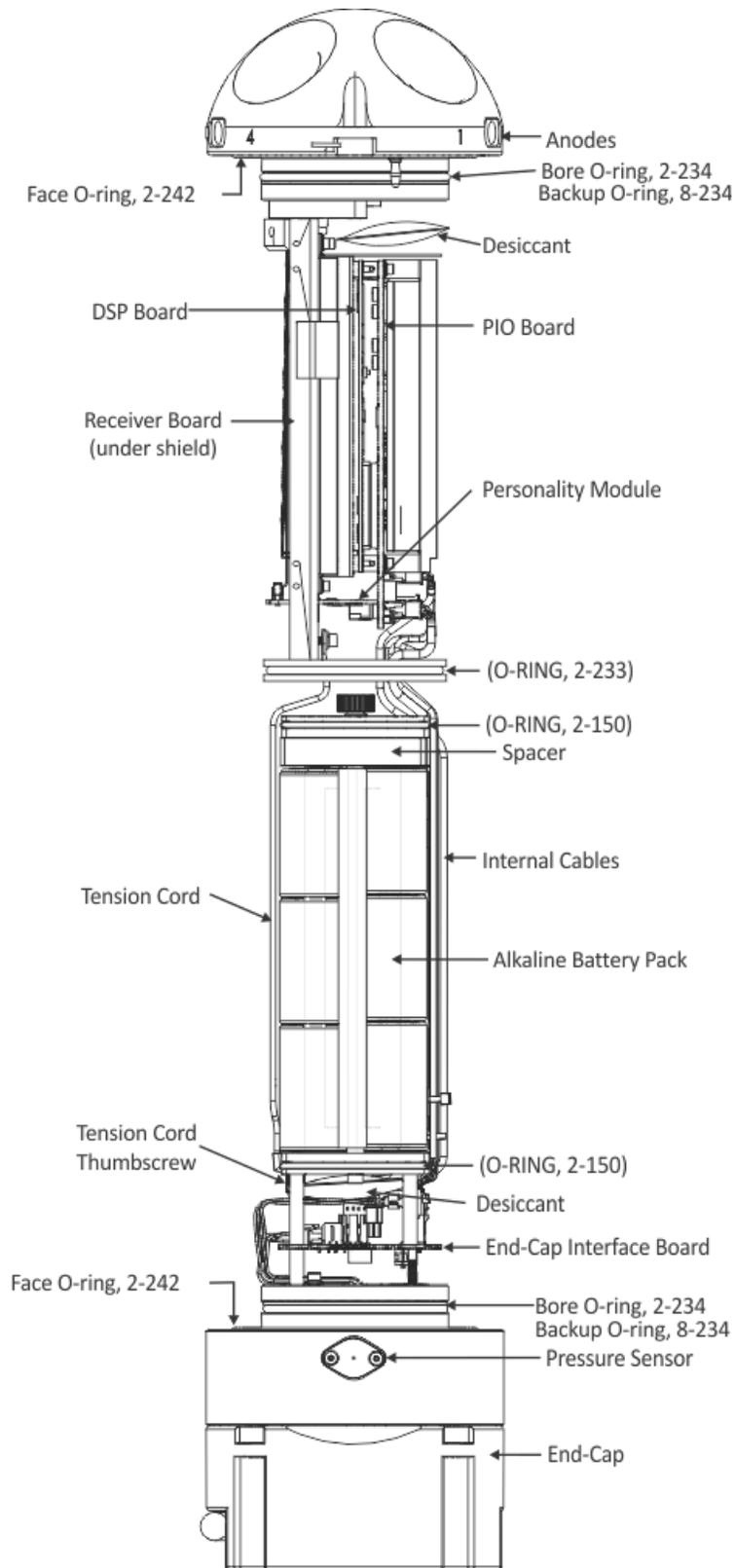


Figure 14. DVS Internal Parts Overview (6000 meter System with Pressure Sensor)

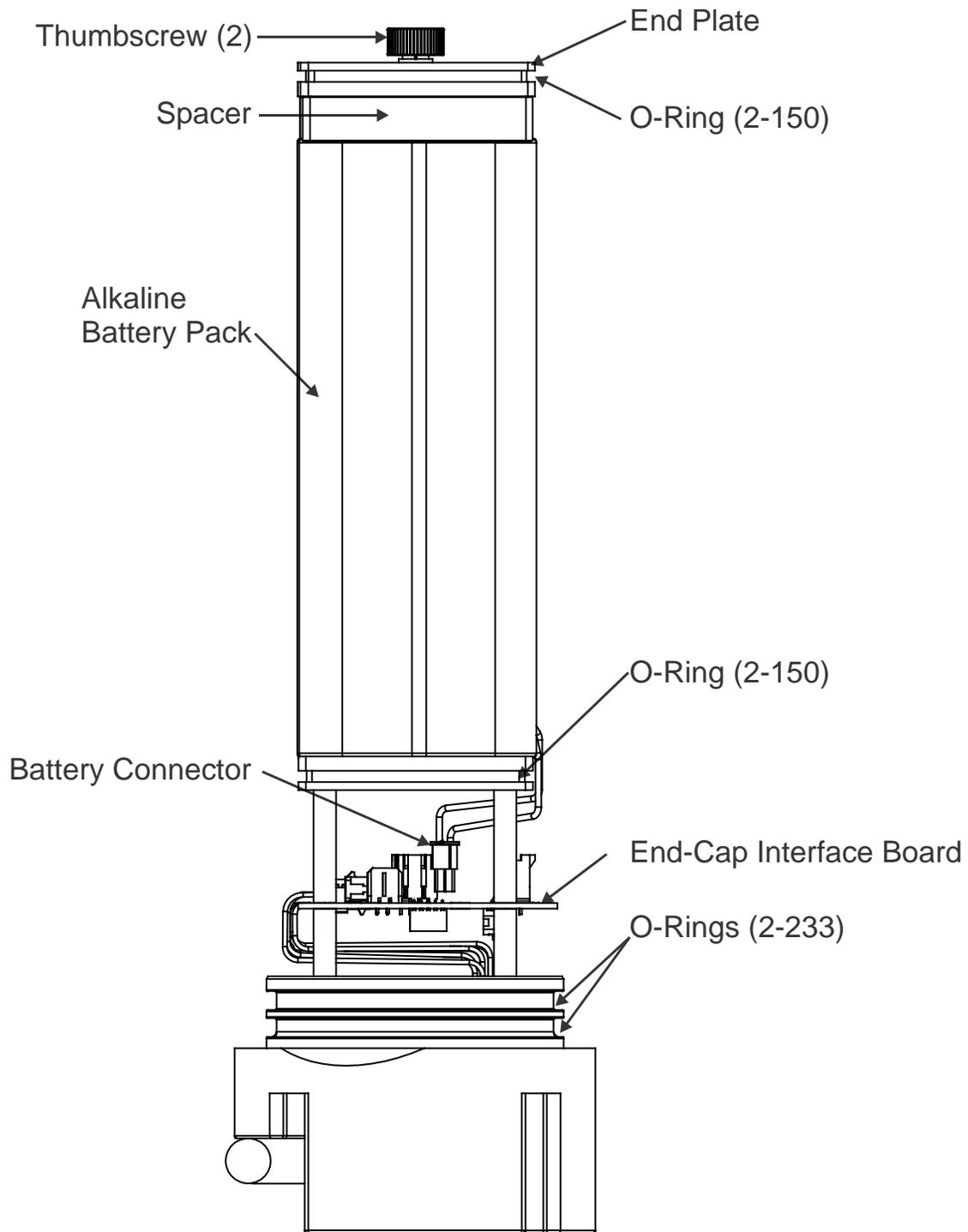


Figure 15. End-cap and Battery Pack Parts Location (Standard 750 meter System)

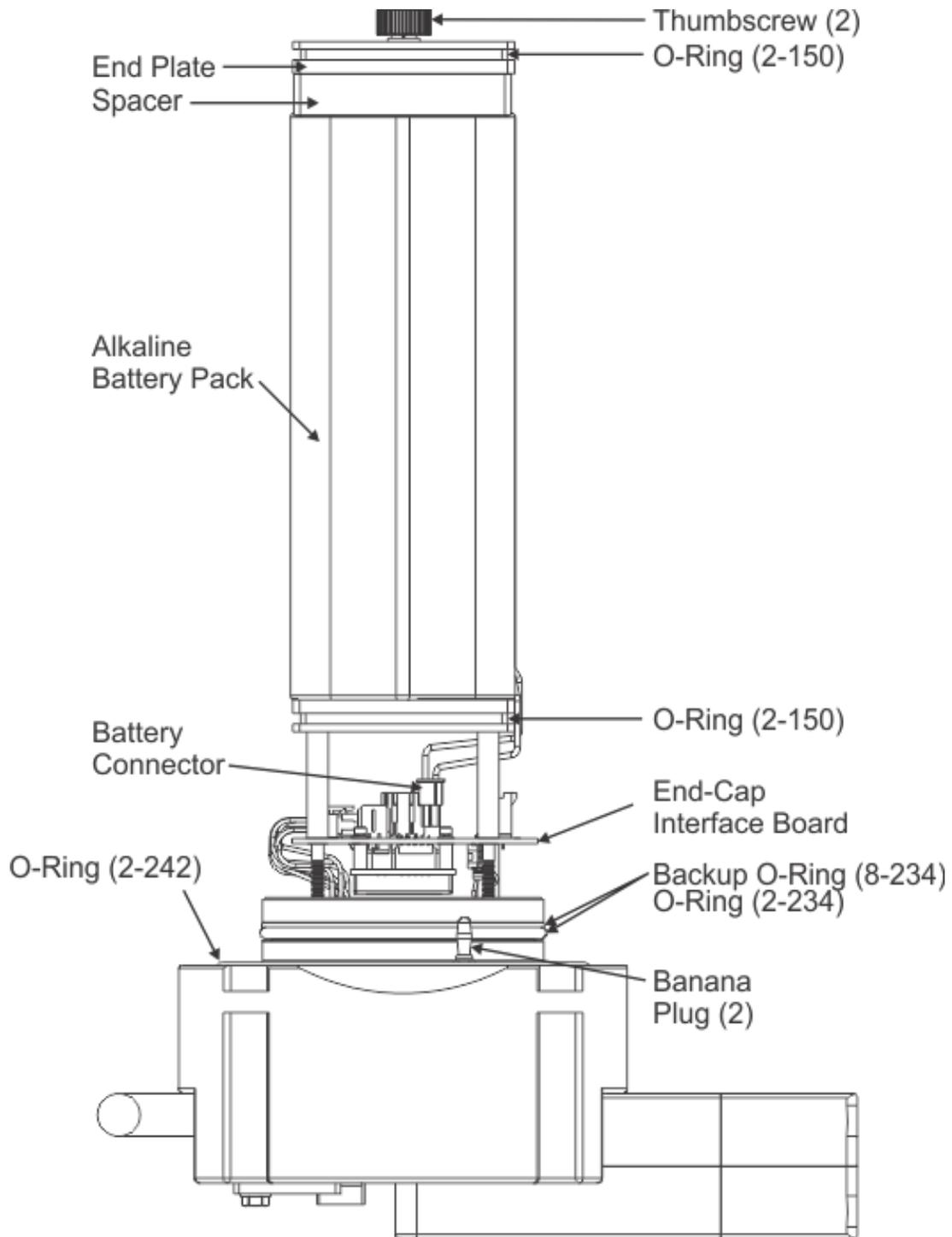


Figure 16. End-cap and Battery Pack Parts Location (6000 meter System)

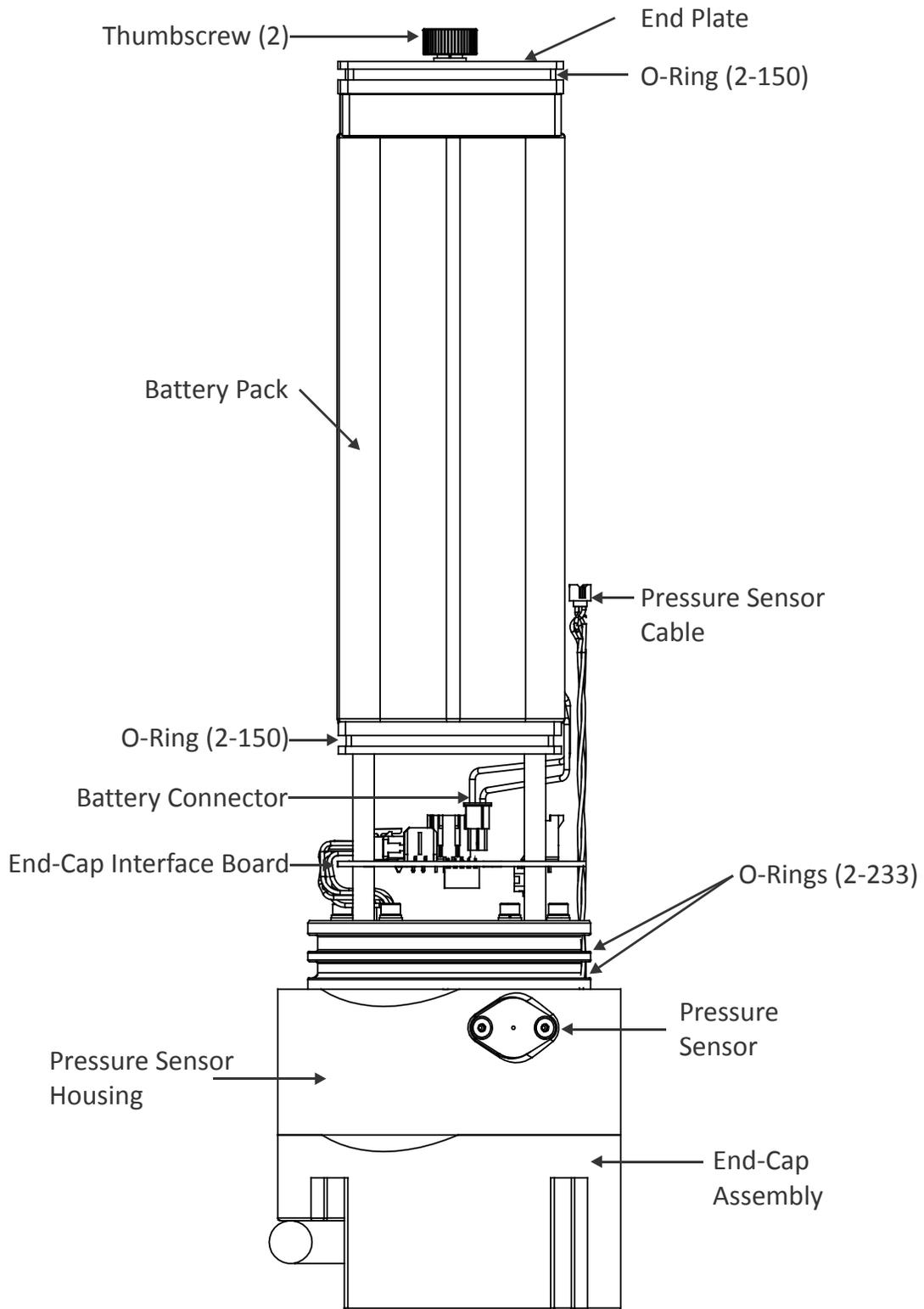


Figure 17. End-cap and Battery Pack Parts Location with Pressure Sensor (750 meter System)

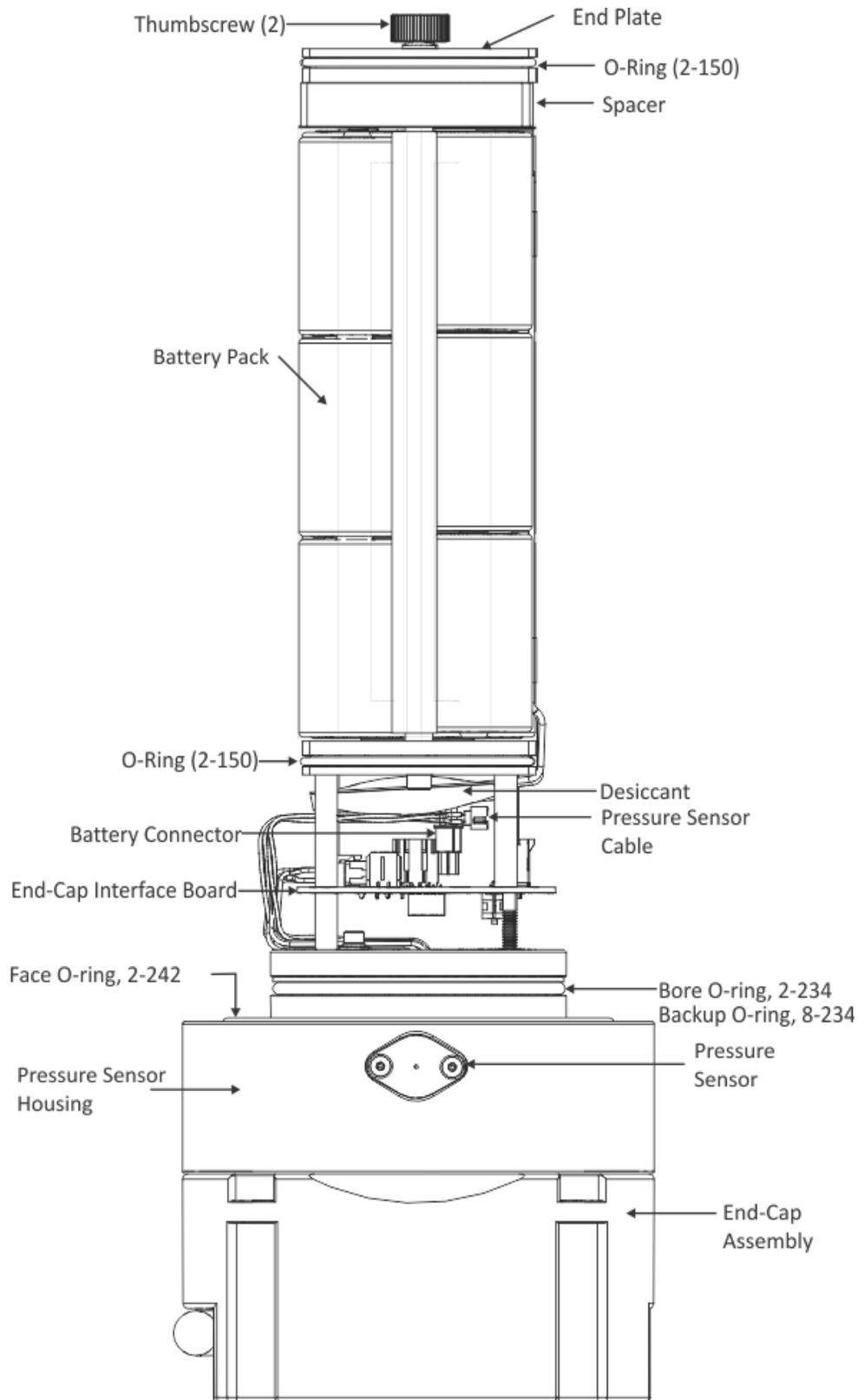


Figure 18. End-cap and Battery Pack Parts Location with Pressure Sensor (6000 meter System)

# Visual Inspection of the DVS

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

**Table 1: Visual Inspection Criteria**

Item	Inspection Criteria
Inductive Modem	For DVS systems with the inductive modem, check the urethane face. There should be no gouges, dents, scrapes, or peeling (see Figure 19).
I/O Cable	Check the cable connector for cracks or bent pins. Check the entire length of the cable for nicks or cuts.
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. Use light amounts of silicone lubricant (such as 3MTM Silicone Lubricant (Dry Type) ID No: 62-4678-4930-3) on both the male pins and female socket to help seat the cable connectors. Wipe off excessive silicone spray from the metal portions of the pins. <b>Regular lubrication is required: Apply dry type silicone lubricant prior to each connection.</b>
Transducer Assembly	Check the urethane faces (see Figure 20). 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, hairline cracks, and damage that may affect watertight integrity or transducer operation. Repair of the transducer faces should only be done by TRDI.
Housing Assembly	For DVS 6000 meter systems, check the paint. 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.
Temperature Sensor	For DVS systems with the Sea-Bird thermistor, check that the sensor is not bent and the guard is attached (see Figure 20).
Pressure Sensor	For DVS systems with pressure sensors, check that the hole in the sensor cover is not blocked by debris or bio-fouling (see Figure 39).

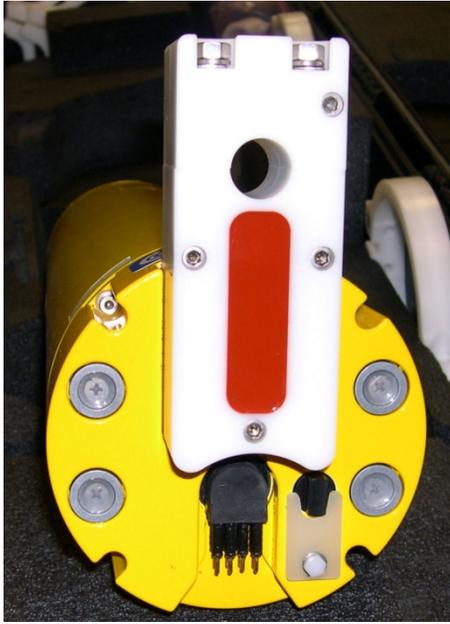


Figure 19. DVS End-Cap View with Inductive Modem (6000 meter DVS)



Figure 20. DVS Transducer with Sea-Bird Thermistor (750 meter DVS)

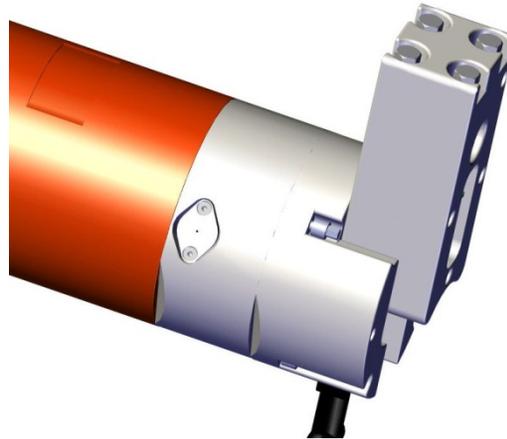


Figure 21. Optional Pressure Sensor (750 meter Shown)

# Spare Parts

Table 2 lists the items in the spares parts kit. Use this kit when doing routine DVS maintenance.

**Table 2: 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



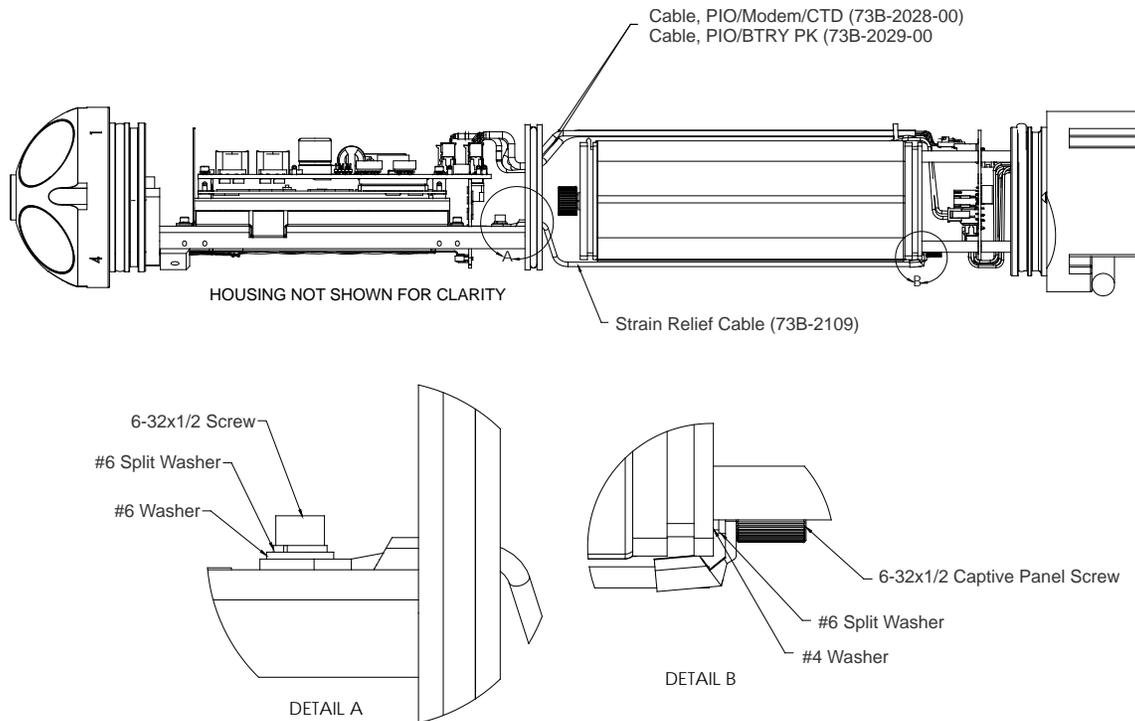
Items 1 – 8 are included with all systems. Item 9 is used on the standard DVS only. Items 10-21 are used on the 6000 meter DVS system.

# DVS Disassembly and Assembly

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.

- [750 Meter DVS Disassembly](#)
- [750 Meter DVS Assembly](#)
- [6000 Meter DVS Disassembly](#)
- [6000 Meter DVS Assembly](#)

## Tension Cord



**Figure 22. Tension Cord Overview**

When disassembling the DVS, keep in mind that there are cables connected to both the end-cap and transducer assemblies. The green strain relief cable shown in Figure 22 prevents the transducer/end-cap assemblies from being pulled too far away from the housing which could cause damage to the internal cables.



Before handling any of the new or original boards, you must be sure that you always wear an earth-grounding static protection strap. The electronics in the DVS are very sensitive to electro-static discharge (ESD). ESD can cause damage that will not be seen immediately and will result in early failure of electronic components.

## 750 Meter DVS Disassembly

If you have a standard 750 meter DVS, use the following procedures to remove the end-cap and transducer head.



The end-cap must always be removed before the transducer head can be removed.

### Removing the 750 Meter End-Cap



#### CAUTION

Wear safety glasses and keep head and body clear of the end-cap while opening. Any system that was deployed may have pressure inside the housing.

To remove the end-cap:

1. Dry the outside of the DVS.
2. Lay the DVS on its side on a soft pad.
3. Remove all power to the DVS.
4. Loosen the four M4 retaining bolts or M4 threaded rods with M4 nut holding the end cap sufficiently to allow pressure relief (see Figure 23 and Figure 24). **Allow the system the opportunity to vent while the bolts are being loosened.** If you note that the end cap moves as you loosen the bolts then this may indicate that internal pressure is present. Be sure to only loosen the bolts far enough to allow the system to vent.



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

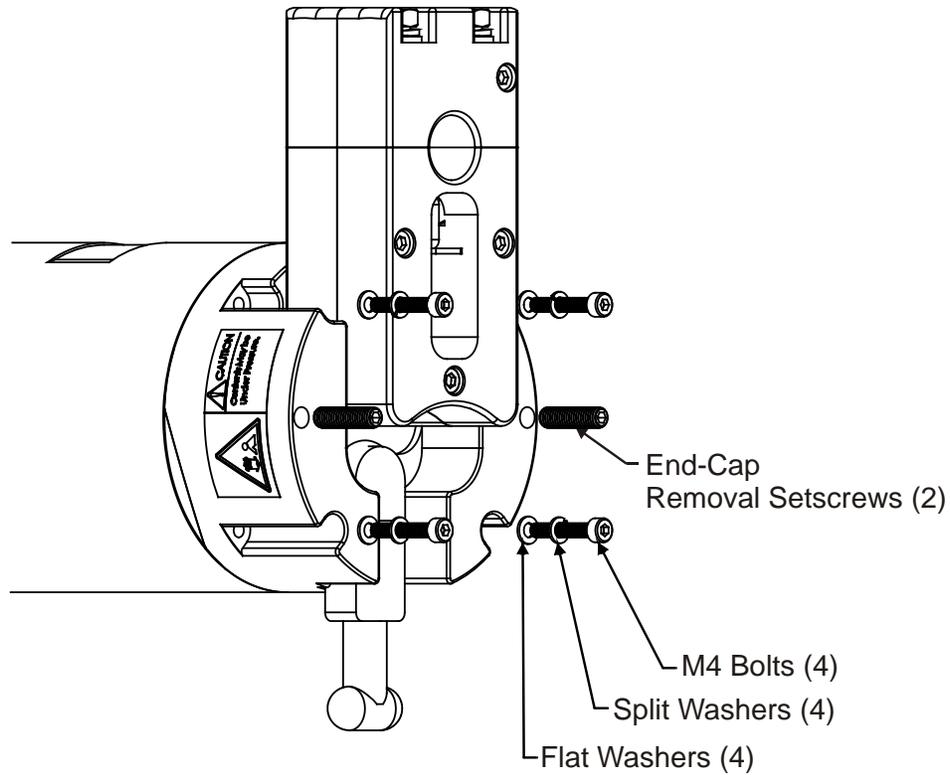


The 750 meter DVS housing end-cap side of the housing has two metal inserts to protect the housing from the End Cap Removal setscrews.

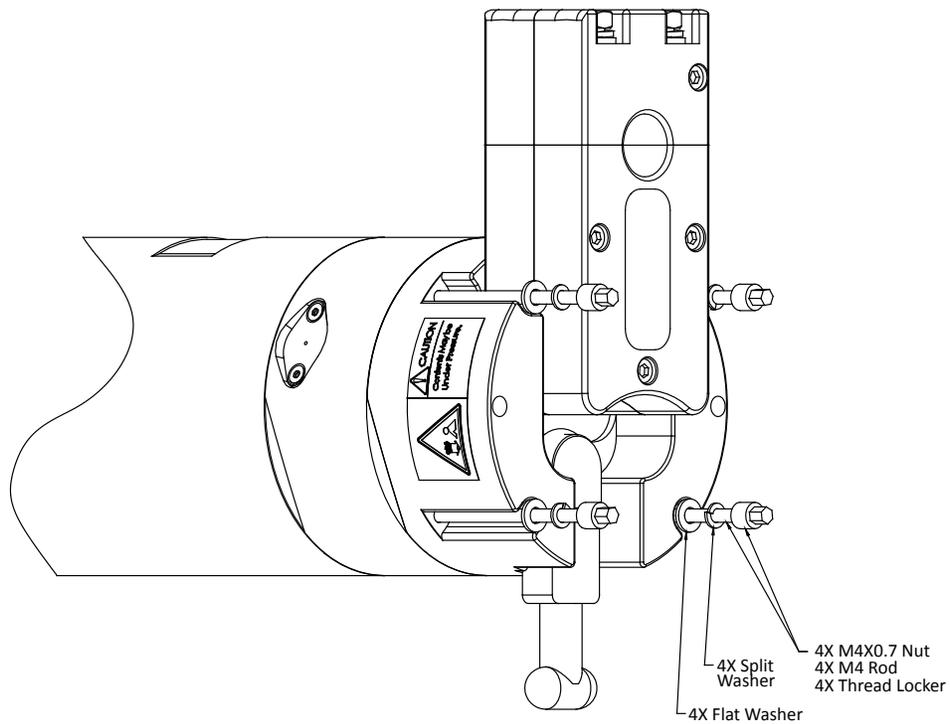
The End Cap Removal M6 setscrews use the same size hex key as the M4 bolts.

DVS systems with a pressure sensor use a M4 threaded rod with a M4 nut rather than a M4 bolt. The M4 nut should remain firmly bonded to the M4 threaded rod.

5. Begin threading both the End Cap Removal M6 setscrews in as shown in Figure 23 to back the end cap out of the housing.
6. Once any possible over pressure has been released, remove the four M4 retaining bolts or M4 threaded rods with M4 nut.



**Figure 23. End Cap Mounting Hardware (Standard 750 Meter System)**



**Figure 24. End Cap Mounting Hardware (with Pressure Sensor)**

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

8. 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 25). If the system has a pressure sensor, than disconnect the pressure sensor cable (Figure 17).
9. Disconnect the strain relief cable (green wire).
10. Gently pull the end-cap and battery assembly away from the housing.



Figure 25. Removing the End-cap

## Removing the 750 meter Transducer Head Assembly

To remove the transducer head:



The end-cap must always be removed before the transducer head can be removed.

1. Remove all power to the DVS.
2. Lay the DVS on its side on a soft pad.
3. Remove the end-cap first. The cables and strain relief cable must be disconnected on the end-cap side before the transducer head assembly can be removed.
4. Remove the four M4 retaining bolts.
5. Create a wedge from a piece of 1/8 inch thick plastic (see Figure 26). Use a belt sander to bevel one edge approximately 30 to 60 degrees.

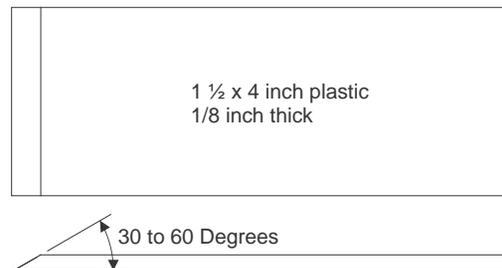


Figure 26. Plastic Wedge

6. Use the plastic wedge to gently pry the transducer head from the housing. It may help to have two people – one pulling on the housing while the second person uses the plastic wedge between the housing and the transducer head.



**Figure 27. Removing the Transducer Head from the Housing**

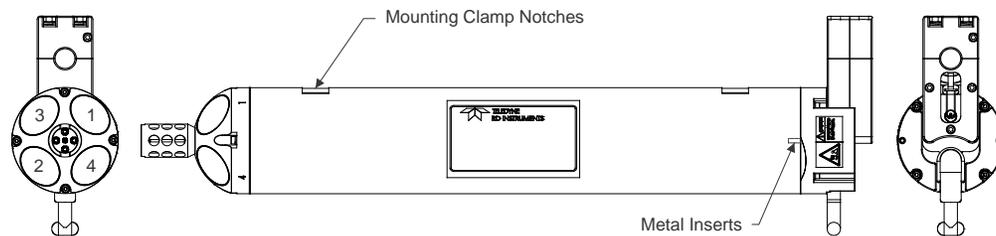


The plastic surfaces on the transducer head and housing must not be damaged. Do not use metal or sharp tools to pry the transducer head from the housing.

- Carefully slide out the transducer head assembly. The electronic chassis and the internal cables are attached to the transducer head. Pull the transducer head assembly all the way out of the housing and place on an anti-static mat.

## 750 Meter DVS Assembly

Use the following procedures to reassemble the 750 meter DVS. The transducer head must be installed first, and then the end-cap can be installed.



**Figure 28. DVS Assembly – 750 Meter**



Note the position of the mounting clamp notches and metal inserts on the housing. Only the end-cap side of the housing has the metal inserts.

## Installing the 750 Meter Transducer Head

To install the transducer head assembly:

- Lay the DVS on its side on a soft pad.
- Install new transducer head O-rings. Inspect, clean, and lubricate the O-rings. Apply a very thin coat of silicone lube on the O-ring.



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.

- Replace the desiccant bags. Place the desiccant bag between the transducer head and the circular separation plate.
- Gently lower the transducer head/electronic/cables/strain relief wire into the housing, aligning the mating holes and orient the housing so that the mounting clamp notches match Figure 28.

Thread the cables through the housing. When mating the housing with the transducer head flange try to apply equal pressure to all parts of the O-rings. Make sure the O-rings remain in the retaining groove.



Check that no cables 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.



The end-cap side of the housing has two metal inserts to protect the housing from the back out screws. Insert the transducer assembly into the side that does NOT have the two metal inserts.

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



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

6. Install all four sets of hardware until “finger tight.”
7. Tighten the bolts in small increments in a “cross” pattern until the split washer flattens out, and then tighten each bolt  $\frac{1}{4}$  turn more to compress the face seal O-ring evenly. Tighten the bolts to the recommended torque value of  $1.2 \pm 0.2$  Nm ( $10.62 \pm 1.7$  Pound-Force Inch). Do not deform the plastic.



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.

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 of  $1.2 \pm 0.2$  Nm ( $10.62 \pm 1.7$  Pound-Force Inch).

## Installing the 750 Meter End-Cap



The transducer head assembly must be replaced first before installing the end-cap.

To install the end-cap:

1. Lay the DVS on its side on a soft pad.
2. Install new end-cap O-rings. Inspect, clean, and lubricate the O-ring on the end-cap/battery assembly. Apply a very thin coat of silicone lube on the O-ring.



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. Connect the strain relief cable (green wire), split washer, and flat washer.



Although the strain relief cable thumbscrew has a screwdriver slot, do NOT use any tools to tighten the screw. Over-tightening can cause the threads to strip.

4. Connect the three gray cables going to the End-Cap Interface Board. If the system has a pressure sensor, then connect the pressure sensor cable (Figure 17).
5. Connect the four-pin red/black battery pack power cable. This connector is clearly labeled Battery Pack on the End-Cap Interface Board.
6. Thread back the End-Cap Removal setscrews so they do not obstruct installing the end-cap.
7. Slide the end-cap into the end-cap side of the housing making sure that the acoustic modem is aligned with the cable clamp notches (see Figure 28).



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

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



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.

9. Examine the end-cap assembly nuts, bolts or threaded rods, and washers for corrosion; replace if necessary. Figure 23 and Figure 24 shows the assembly order of the end-cap mounting hardware. All the hardware items are needed to seal the DVS properly.



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

For systems with a pressure sensor assembly, the M4 nut needs to be firmly bonded to the M4 threaded rod. Apply several drops of thread locker to the M4 threaded rod 8.9 mm (0.35 inches) from the tip. Attach the M4 nut and wipe off excess thread locker from the threaded rod. Allow the thread locker to cure for 24 hours before deploying the DVS.

10. Install all four sets of hardware until “finger-tight.”
11. Tighten the bolts in small increments in a “cross” pattern until the split washer flattens out, and then tighten each bolt  $\frac{1}{4}$  turn more to compress the O-rings evenly.
12. Tighten the bolts to the recommended torque value of  $1.2 \pm 0.2$  Nm ( $10.62 \pm 1.7$  Pound-Force Inch).



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.

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 of  $1.2 \pm 0.2$  Nm ( $10.62 \pm 1.7$  Pound-Force Inch).

## 6000 Meter DVS Disassembly

If you have a 6000 meter DVS, use the following procedures to remove the end-cap and transducer head.



The end-cap must always be removed before the transducer head can be removed.

### Removing the 6000 Meter End-Cap

To remove the 6000 meter housing end-cap:

	<b>CAUTION</b>
	<p>Wear safety glasses and keep head and body clear of the end-cap while opening. Any system that was deployed may have pressure inside the housing.</p>



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

1. Dry the outside of the DVS.
2. Lay the DVS on its side on a soft pad.



Make sure to protect the DVS paint. Avoid any movements that may scratch the paint as this increases the chance of corrosion during deployment.

3. Remove all power to the DVS.
4. Using an L-wrench only, loosen one of the M4 bolts three turns as shown on the Instruction Label located on the end-cap.

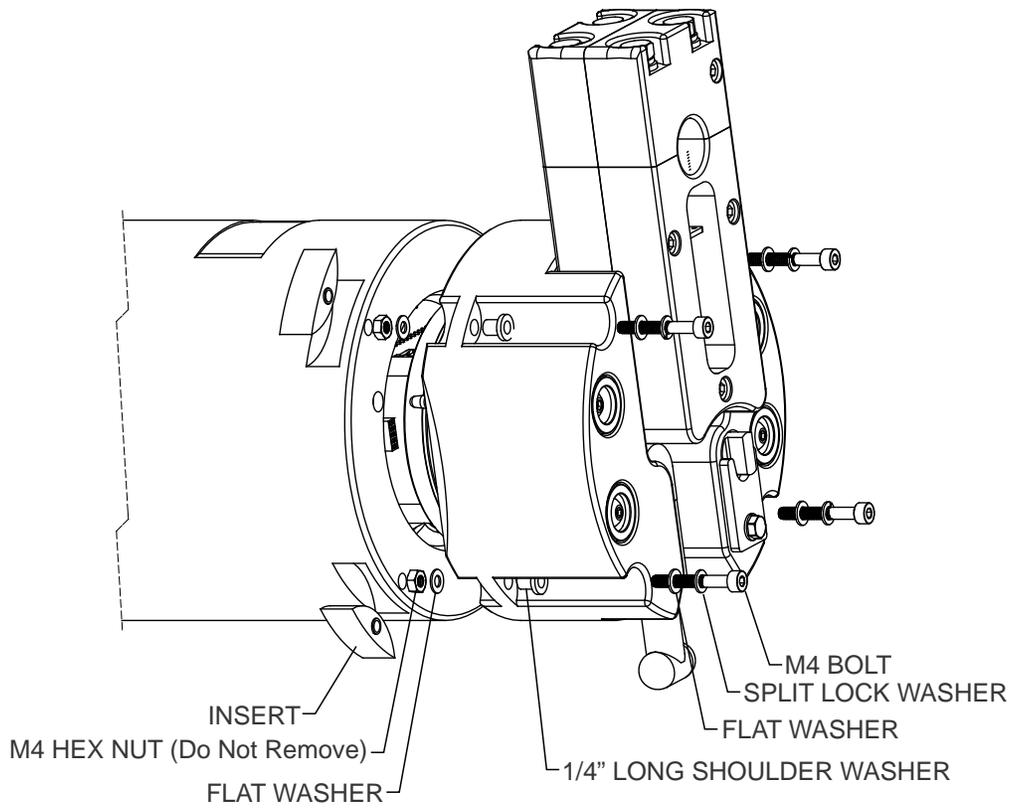


Figure 29. Instruction Label

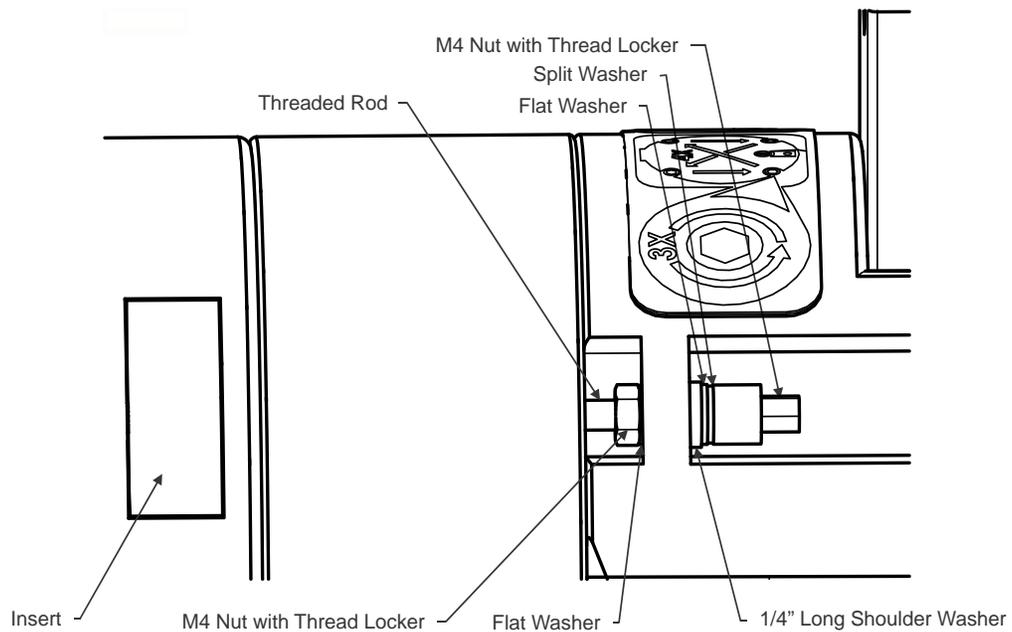


Do not loosen or remove the M4 hex nut.

5. Move to the next bolt in a crisscross pattern as indicated by the instruction label and loosen that bolt three turns.
6. 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. **Allow the system the opportunity to vent while the bolts are being loosened.**
7. Once any possible over pressure has been released, completely loosen the four M4 retaining bolts.



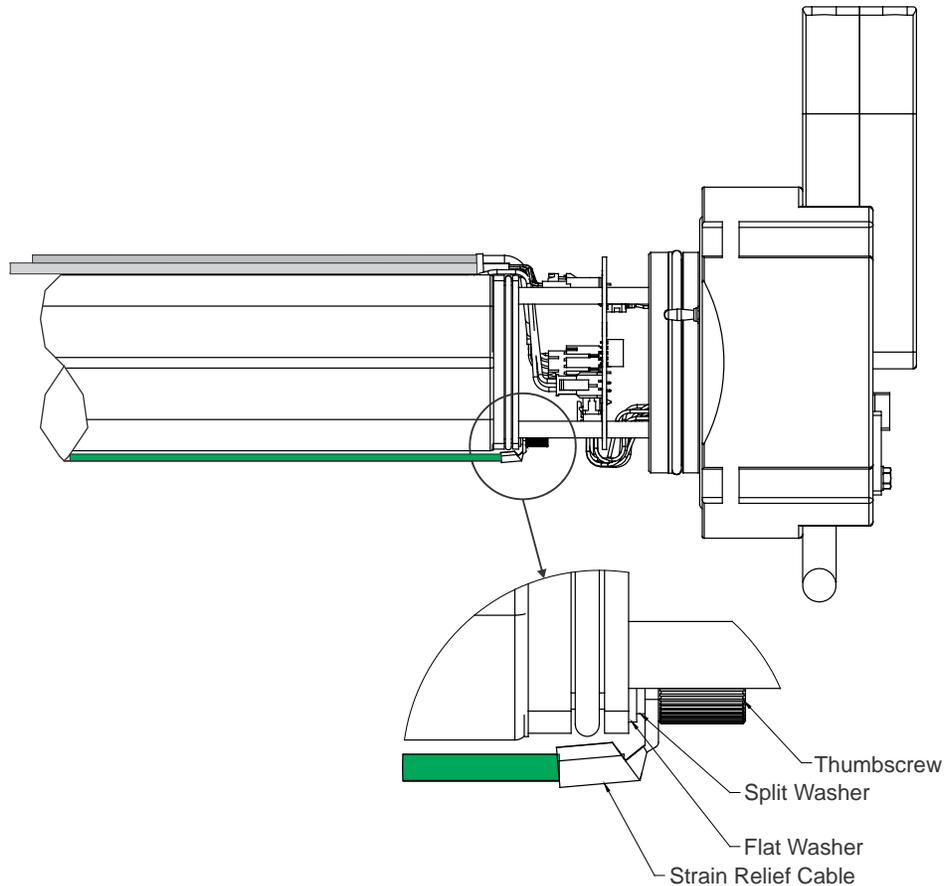
**Figure 30. High Pressure End Cap Mounting Hardware**



**Figure 31. High Pressure End Cap Mounting Hardware (with Pressure Sensor)**

 The end-cap hardware will stay attached to the end-cap.

8. Gently slide the end-cap and battery assembly away from of the housing just enough to allow the cables to be disconnected.
9. 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 25). If the system has a pressure sensor, than connect the pressure sensor cable (Figure 18).
10. Disconnect the strain relief cable (green wire) by removing the screw, washer, and split washer (see Figure 32).
11. Gently pull the end-cap and battery assembly away from the housing.



**Figure 32. Disconnecting the Strain Relief Cable**

## Removing the 6000 Meter Transducer Head Assembly



The end-cap must always be removed before the transducer head can be removed.

To remove the transducer head:

1. Remove all power to the DVS.
2. Lay the DVS on its side on a soft pad.



Make sure to protect the DVS paint. Avoid any movements that may scratch the paint as this increases the chance of corrosion during deployment.

3. Remove the end-cap (see [Removing the End-Cap – 6000 Meter Housing](#)).

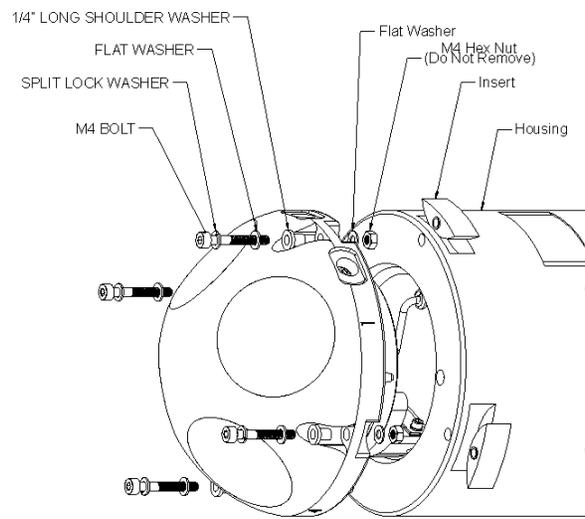


Figure 33. Transducer Head Mounting Hardware

4. Using an L-wrench only, loosen one of the M4 bolts three turns.
5. Move to the next bolt in a crisscross pattern and loosen that bolt three turns.
6. As you repeat step 5, 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.



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



The hardware will stay attached to the transducer head.

7. Carefully slide out the transducer head assembly.

## 6000 Meter DVS Assembly

Use the following procedures to reassemble the 6000 meter DVS. The transducer head must be installed first, and then the end-cap can be installed.

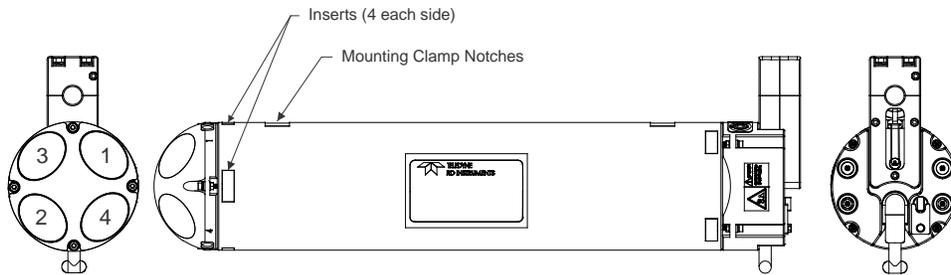


Figure 34. DVS Assembly – 6000 Meter



Note the position of the inserts in reference to the mounting clamp notches on the housing. The transducer side of the housing has the inserts centered with the mounting clamp notches. The end-cap side of the housing has the inserts off-centered.

## Installing the 6000 Meter Transducer Head

To install the transducer head:

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



Make sure to protect the DVS paint. Avoid any movements that may scratch the paint as this increases the chance of corrosion during deployment.

2. Install new transducer head O-rings. Inspect, clean, and lubricate the O-ring on the transducer head.
3. Replace the desiccant bags. Place the desiccant bag between the transducer head and the circular separation plate.
4. Orient the housing so that the mounting clamp notches and inserts match Figure 34. The transducer side of the housing has the inserts centered with the mounting clamp notches.
5. Gently slide the transducer head/electronics/cables/strain relief wire into the housing. Align the mating holes and make 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.



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.

6. Examine the transducer assembly nuts, bolts, and washers for corrosion; replace if necessary. Figure 33 shows the assembly order of the transducer mounting hardware. All hardware items are needed to seal the DVS properly.



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 36). Tighten the M4 nut “finger tight”.

7. Check the inserts:

- a. Press one end of the insert to cause the other end to lift slightly out of the housing.



- b. Gently pry out the insert using a plastic sharp tool (recommended) or a flat thin screw driver.



Make sure to protect the DVS paint/anodizing. Avoid any movements that may scratch the paint/anodizing surface as this increases the chance of corrosion during deployment.

- c. Inspect the threads and make sure that these are not stripped or worn. If so, replace the insert.



### To replace an insert:

- a. Inserts snap into place with the plastic lip facing the transducer.
- b. Apply pressure on either ends of the insert as necessary to make the insert flush with the housing.



8. 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.



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 step may cause damage to the DVS housing or transducer head.

9. Tighten the bolts to the recommended torque value of  $1.2 \pm 0.2$  Nm (10.62  $\pm$  1.7 Pound-Force Inch).



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 of  $1.2 \pm 0.2$  Nm (10.62  $\pm$  1.7 Pound-Force Inch).

## Installing the 6000 Meter End-Cap



The transducer head assembly must be replaced first before installing the end-cap.

### To install the end-cap:

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



Make sure to protect the DVS paint. Avoid any movements that may scratch the paint as this increases the chance of corrosion during deployment.

2. Install new end-cap O-rings. Inspect, clean, and lubricate the O-ring on the end-cap/battery assembly.
3. Replace the desiccant bag. Place one desiccant bag on top of the end-cap interface board.
4. Slide the end-cap into the housing holding the cables with one hand so they do not get pinched. Only slide the end-cap into the housing far enough to connect the cables. Align the end-cap with the housing as shown in Figure 34.



**Figure 35. Installing the End-Cap**

5. Connect the strain relief cable (green wire) to the battery black top plate. Tighten the screw with the washer and split washer installed.



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

6. For DVS Phase I systems, connect the three gray cables going to the End-Cap Interface Board. For DVS Phase II systems there are two gray cables. The flat 4-pin connects to PIO (J4) connector on the Interface board and the second flat 16-pin connector goes to J1 on the DVSII Interface board. If the system has a pressure sensor, then connect the pressure sensor cable (Figure 18).
7. Connect the four-pin red/black battery pack power cable. This connector is clearly labeled Battery Pack on the End-Cap Interface Board.
8. Now fully slide the end-cap into 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.



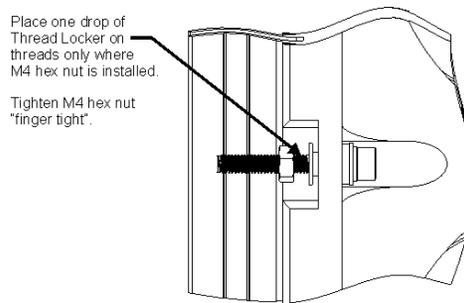
Check that no wires or any other object is pinched between the end-cap and the housing. If the O-rings are not in the groove or if a wire or other object is pinched, the DVS will flood.

9. 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.



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

For systems with a pressure sensor assembly, the M4 nut needs to be firmly bonded to the M4 threaded rod. Apply several drops of thread locker to the M4 threaded rod 8.9 mm (0.35 inches) from the tip. Attach the M4 nut and wipe off excess thread locker from the threaded rod. Allow the thread locker to cure for 24 hours before deploying the DVS.

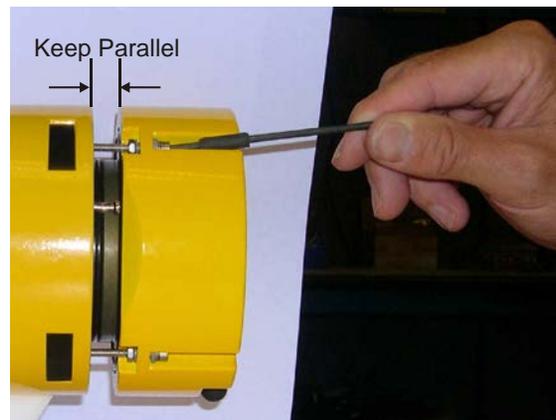


**Figure 36. End-Cap Mounting Hardware Replacement**

10. 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.
11. Check the inserts are not stripped or worn. Inserts snap into place with the metal thread portion facing the end-cap. Replace as necessary (see [Check the inserts](#)).
12. 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.



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 step may cause damage to the DVS housing or end-cap.



**Figure 37. High Pressure End-Cap Replacement**

13. Tighten the bolts to the recommended torque value of  $1.2 \pm 0.2$  Nm ( $10.62 \pm 1.7$  Pound-Force Inch).



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 of  $1.2 \pm 0.2$  Nm ( $10.62 \pm 1.7$  Pound-Force Inch).

# Replacing the DVS Battery Pack

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).



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



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

To replace the battery pack:

1. Remove the end-cap (see [End-Cap Removal Procedures](#)).
2. Disconnect the red/black battery power cable from the end-cap interface board.
3. Loosen the two thumbscrews holding the battery pack onto the posts.
4. Remove the end plate and spacer.
5. Slide out the used battery pack.
6. Slide a new battery pack onto the posts. Make sure the power cable is not pinched by the battery pack.
7. 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.
8. Position the spacer and end plate over the post.
9. Tighten each thumbscrew firmly to hold the battery in place.
10. Connect the red/black battery power cable to the end-cap interface board.



If the DVS will not be deployed within the next hour, use the DVS software to send the CZ command to put the DVS to sleep.

11. Replace the desiccant bag just before sealing the housing (see [Desiccant Bags](#)).
12. Install the end-cap (see [End-Cap Replacement](#)).
13. Align the compass (see [Compass Calibration](#)).

## Switching to the DVS Lithium Battery

Use this procedure to install the lithium battery. The DVS can use either the standard 18 VDC alkaline battery pack or a 23.4 VDC lithium battery pack.

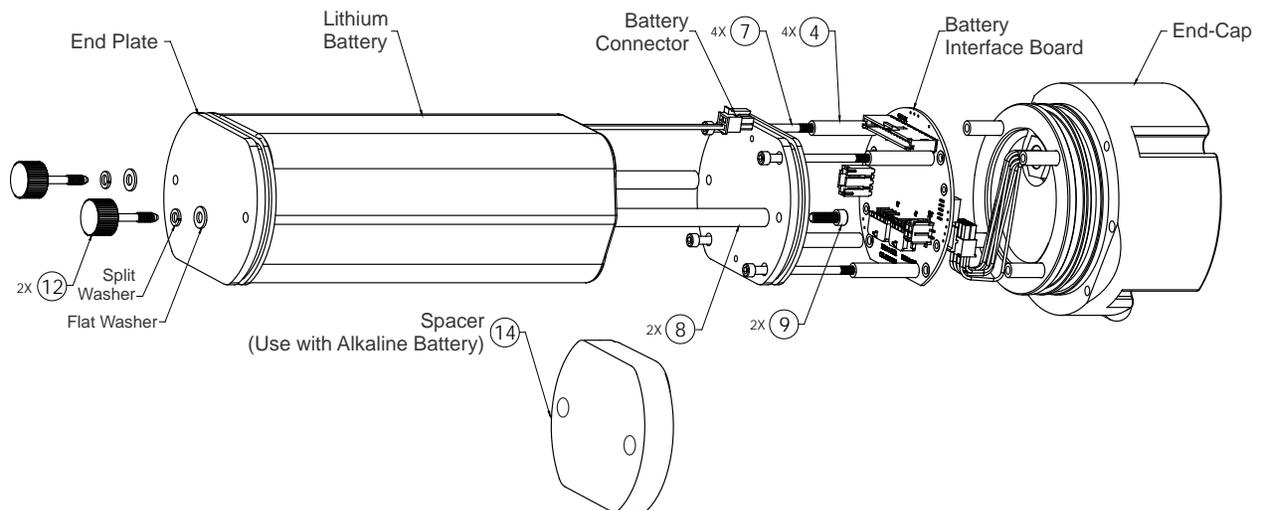
To switch from the Alkaline battery pack to the Lithium battery:

1. Remove the end-cap (see [End-Cap Removal Procedures](#)).
2. Disconnect the red/black battery power cable from the end-cap interface board.
3. Loosen the two thumbscrews holding the battery pack onto the posts.
4. Remove the end plate and spacer. Place the spacer in a safe location for future use. It is not used with the Lithium Battery.
5. Slide out the old alkaline battery pack.

6. Slide a new lithium battery pack onto the braces. Make sure the power cable is not pinched by the battery pack.
7. Test the lithium battery pack voltage by measuring across the battery connector under no-load conditions. The voltage should be +23.4 VDC for a new battery pack.
8. Position the end plate over the braces.
9. Tighten each thumbscrew firmly to hold the battery in place.
10. Replace the desiccant bag just before sealing the housing (see [Desiccant Bags](#)).
11. Install the end-cap (see [End-Cap Replacement](#)).
12. Align the compass (see [Compass Calibration](#)).

## Lithium Battery Upgrade Kit

Use the lithium battery kit if your DVS does not have the longer braces and spacer.



**Table 3. Lithium Battery Kit 75BK6042**

Item #	Description	Quantity
4	Standoff – 92510A126	4
8	Brace	2
12	Thumb Screw	2
14	Spacer	1

To install the Lithium Battery kit:

1. Remove the end-cap (see [End-Cap Removal Procedures](#)).
2. Disconnect the red/black battery power cable from the end-cap interface board.
3. Loosen the two thumbscrews holding the battery pack onto the posts.
4. Remove the end plate. Remove the old thumbscrews from the end plate and replace with new thumbscrews (item 12).
5. Slide out the old alkaline battery pack.

6. Replace both brace (item 8) with the new longer braces by first removing all four 6-32 x 2½ inch long screws (item 7). Then remove both 8-32 x ½ inch long screws (item 9).
7. Attach the brace using the 8-32 x ½ inch long screws (item 9). The screw heads must be flush with the bottom plate. Tighten the 8-32 screws to 22 IN-LB (1.69 N.m).
8. Replace item 4 with the new shorter standoffs. Attach the bottom plate using the 6-32 x 2½ inch long screws (item 7). The screw heads must be flush with the bottom plate. Tighten the 6-32 screws to 8 IN-LB (0.9 N.m).
9. Slide a new lithium battery pack onto the braces. Make sure the power cable is not pinched by the battery pack.
10. Test the lithium battery pack voltage by measuring across the battery connector under no-load conditions. The voltage should be +23.4 VDC for a new battery pack.
11. Position the end plate over the braces.
12. Tighten each thumbscrew firmly to hold the battery in place.
13. Connect the red/black battery power cable to the end-cap interface board.
14. Replace the desiccant bag just before sealing the housing (see [Desiccant Bags](#)).
15. Install the end-cap (see [End-Cap Replacement](#)).
16. Align the compass (see [Compass Calibration](#)).

# 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 an accurate measurement. Please be aware of the following items:

- **TRDI recommends 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 the DVS mounting fixture or frame or any instrument attached to the DVS has some magnetic field or magnetic permeability, **calibrate the DVS inside the fixture and/or with all instruments attached.** Depending on the strength and complexity of the fixture's field, the calibration procedure may be able to correct it.
- Calibrate the DVS compass as close to the location that it will be deployed and as far away as possible from objects that have magnetic fields that could result in a poor calibration. **Common objects to avoid calibrating the compass near include steel reinforced concrete, buildings, and automobiles.**
- **It is important that the DVS compass be calibrated in the same orientation in which the DVS is to be deployed.** This means that if the DVS is deployed with its transducer facing upward, the DVS compass should be calibrated with the transducer facing upward and vice versa.



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, a compass calibration must be performed.



No factory calibration was done on the compass in the 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.



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

9600 baud is too slow for communicating between the software and the DVS for compass calibration. Since the IMM communicates at 9600 baud (default), TRDI recommends that users always perform compass calibrations while connected serially at 115200 baud.

## Compass Background

The compass calibration algorithm collects magnetic field vector information for various measured headings during the calibration. Hard and soft iron effects rotating with the compass are made observable during the calibration by causing the local field to be perturbed as the compass is spun during the calibration. That is, each component of the hard and soft iron has to alternately increase the local field for some orientations and decrease for orientations 180 degrees (or 90 degrees for soft iron) from those orientations for the algorithm to "notice" it. Tilting and rotating the compass about the vertical axis is sufficient to do this.

# Compass Calibration Procedure

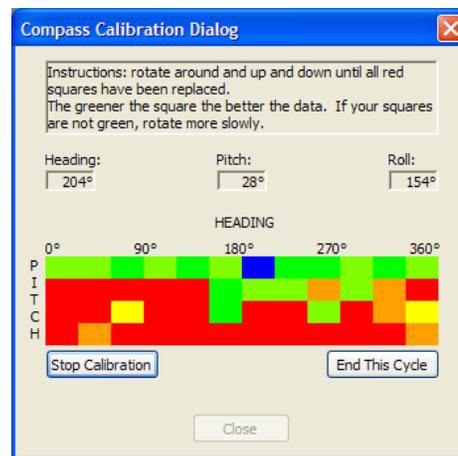
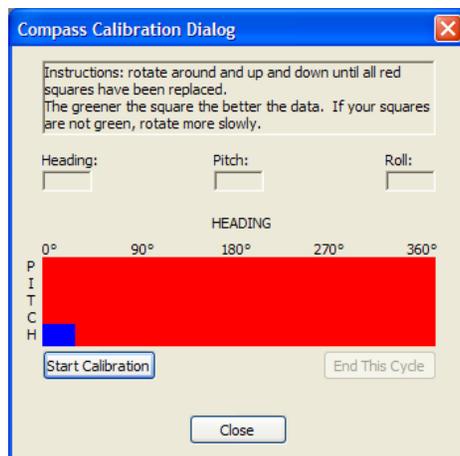
To calibrate the compass:

1. Connect and power up the DVS as shown in the DVS User's Guide. Use the end-cap connector I/O cable or internal test cable to communicate with the DVS.
2. Start the *DVS software*.
3. At the **DVS Wizard Startup Options** screen, click **Cancel**. Navigate to **Serial Communications...** On the **Configure** menu, select the COM port and baud rate. Select 115200 baud.
4. On the **Tools** menu, click **Calibrate DVS Compass...**
5. Position the DVS in the same vertical orientation that the DVS will be deployed (i.e. with transducer facing upward if the DVS is to be deployed with transducer facing upward and vice versa).



For downward facing DVS systems do not place the transducer head on a hard surface. Be sure to protect the urethane beams from damage.

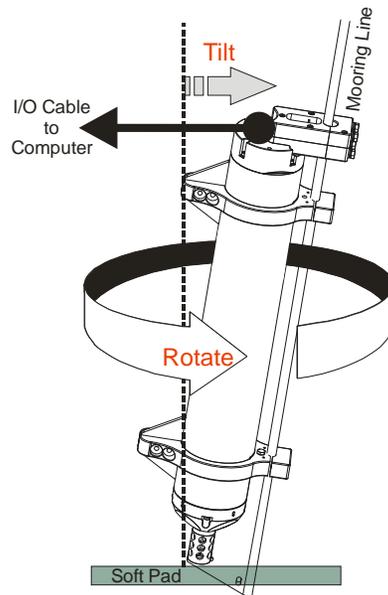
6. Start the compass calibration by clicking the **Start Calibration** button.



7. As the DVS is rotated and pitched, the squares will change color. The blue square indicates where the DVS is in the rotations. A good compass calibration requires slow, smooth movement to allow the compass to collect data at each point.
  - Green – Good
  - Light Green – Acceptable
  - Yellow – Within parameters (one or two yellow squares for the entire rotation is OK)
  - Orange – Unacceptable - Rotate slower!
  - Red – Not measured



Although filling the matrix with green squares improves the calibration, it does not guarantee an acceptable compass error. Compass error is based not only on the quantity of measurements made during the calibration but also the quality of the magnetic environment. Attempting to calibrate the compass in a poor environment, e.g., near fixed ferrous objects, will likely result in an unacceptable compass error regardless of how green the calibration matrix is.



**Figure 38. Compass Calibration**



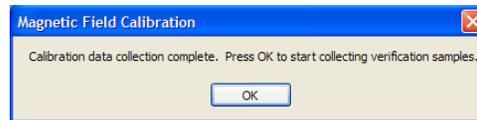
Fixture (recommended)



Hand Calibration

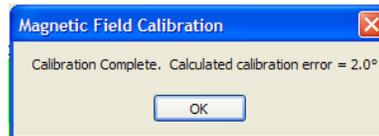
- Tilt the DVS to about 25° from vertical along Beam 4.
- Rotate the DVS, relative to vertical, 360° clockwise while maintaining the 25° angle along Beam 4.
- Tilt the DVS to about 6° from vertical along Beam 4.
- Rotate the DVS, relative to vertical, 360° counter clockwise while maintaining the 6° angle along Beam 4.
- Tilt the DVS to about 25° from vertical along Beam 3.
- Rotate the DVS, relative to vertical, 360° clockwise while maintaining the 25° angle along Beam 3.
- Tilt the DVS to about 6° from vertical along Beam 3.
- Rotate the DVS, relative to vertical, 360° counter clockwise while maintaining the 6° angle along Beam 3.

8. Once the calibration matrix has been completely filled, the software will prompt the user to repeat the process described above in order to verify the calibration.
9. Select **OK** and repeat the calibration procedure.

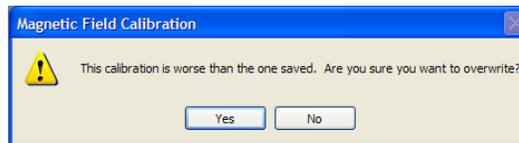


10. When the compass calibration verification step is complete, there are three possible outcomes.

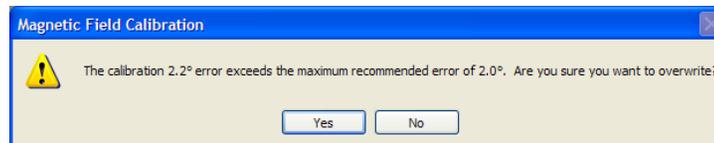
- If the calibration error is  $2.0^\circ$  or less, than the *DVS* software will display the heading error. Click **OK**.



- If the calibration results in a heading error worse than the error currently stored in the *DVS* compass the *DVS* software will display a window informing the user that the calibration is worse than the one saved. Click **Yes** to overwrite the saved calibration or **No** to keep the original calibration.



- If the compass calibration results in a heading error that is greater than the maximum recommended error ( $2.0^\circ$ ) the *DVS* software will display a window informing the user of the excessive heading error. Click **Yes** to overwrite the saved calibration or **No** to keep the original calibration.



If the compass calibration results in a heading error that is both greater than the error already saved and greater than the maximum recommended error, both windows from outcomes 2 and 3 are displayed.

# Periodic Maintenance

Based on experience, TRDI knows that **most** systems need to have the urethane inspected after 2 to 3 years of field use. Many users are not familiar with the early signs of urethane failure. The primary damage to the urethane is from bio-fouling and long exposure to the water and sun. Damage occurs on the surface of the urethane and at the edge where the urethane bonds to the cups. By returning the system every 2 to 3 years, TRDI can inspect it for early signs of urethane failure and repair it through our Refurbishment Service. At the same time, we will make any necessary upgrades to boards, assemblies, and firmware. If the Refurbishment Service is not needed, TRDI can upgrade your system as part of our Inspection Services. With proper care, general maintenance, and routine service periods ensures that your DVS lasts for a minimum of 10 years with no loss in performance.

## 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.

TRDI strongly recommends 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.



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

### Standard 750 meter DVS System

- End-cap assembly, two 2-233 O-rings
- Optional Pressure sensor assembly, same O-rings as end-cap assembly
- Transducer assembly, two 2-233 O-rings
- Battery assembly, 2-150 (for vibration prevention, not watertight)
- Electronics assembly, 2-233 (for vibration prevention, not watertight)

### 6000 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
- Optional Pressure sensor assembly, same O-rings as end-cap assembly
- Battery assembly, 2-150 (for vibration prevention, not watertight)
- Electronics assembly, 2-233 (for vibration prevention, not watertight)



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.

### To replace the O-rings:

1. 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.).



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

2. 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.



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

3. 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.
4. Lubricate the O-ring with a thin coat of silicone lubricant (Table 2). Apply the lubricant using latex gloves. Do not let loose fibers or lint stick to the O-ring. Fibers can provide a leakage path.



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



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.

## Replacing the 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 2) whenever you are preparing to deploy or store the DVS for an extended time.



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

Do not puncture or tear the desiccant bag. Do not use desiccant bags that are torn or open.



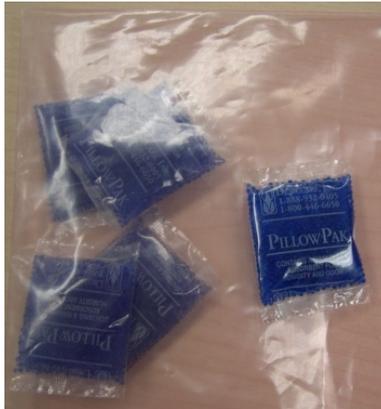
Desiccant bags are shipped in a zip lock bag to ensure maximum effectiveness. TRDI recommends replacing the desiccant bag just before the deployment.

The desiccant should be replaced on a yearly basis or whenever the system is recovered from a deployment.

### To replace the desiccant:

1. Remove the end-cap and transducer head (see [DVS Disassembly and Assembly](#)).
2. 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 (see Figure 11 and Figure 12).

3. Install the transducer head assembly and end-cap (see [DVS Disassembly and Assembly](#)).



## Prevention of Biofouling

This section explains how to prevent the buildup of organic sea life (biofouling) on the transducer faces. Objects deployed within about 100 meters ( $\approx 328$  feet) of the surface are subject to biofouling, especially in warm water. This means DVS systems are subject to biofouling. 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. Therefore, you should take steps to prevent biofouling during shallow water deployments.

Some organizations may decide to use antifouling grease. However, most antifouling greases are toxic and may cause problems. Recent tests suggest antifouling grease may cause the urethane on the transducer faces to develop cracks. Warmer temperatures accelerate this effect. If using antifouling grease, remove the grease immediately after recovering the DVS from its deployment. Remove the grease with soapy water because cleaning solvents may also cause the urethane to crack. Be sure to wear protective gloves and a face shield.

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.



If using antifouling grease, remove it immediately after recovering the DVS. 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.

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.

## 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 : <a href="http://www.yachtpaint.com/usa/">http://www.yachtpaint.com/usa/</a>



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

## Applying Antifouling Paints

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



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, TRDI recommends 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).



As originally manufactured, the transducer faces have a smooth surface which makes it inhospitable for most biofouling to develop. Preserving this smooth surface is an effective way to prevent heavy biogrowth on the transducer faces. However, if an antifouling coating is desired on the transducer faces, then the faces must be lightly abraded to allow for the antifouling coating to adhere. **As a rule, the surface must be kept smooth unless an antifouling coating will be applied.**

1. Transducer Face Surface Preparation - Lightly abrade the surface using Scotch Brite® to remove gloss. Thoroughly clean the areas to be painted with soapy water and dry.
2. Surface Application:
  - Mask as necessary to avoid having the antifouling paint come in contact with any bare metal surfaces.
  - Apply an even, thin layer (0.1mm, 4mil per coat) of antifouling paint. If more than one coat is needed to reach the maximum thickness, allow each coat to dry for 16 hours.
  - When applying paint to the urethane faces, use extra caution to apply a smooth, thin coat of paint.



Do not paint the white Delrin portions of the DVS end-cap, inductive modem, and transducer head. The paint will not stick to Delrin.

## Removing Biofouling

To remove foreign matter and biofouling:

1. Remove soft-bodied marine growth or foreign matter with soapy water. Waterless hand cleaners remove most petroleum-based fouling.



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. The urethane coating on the transducer faces could be damaged.

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, but TRDI does 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.



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. If you do not think you can remove barnacles without damaging the transducer faces, contact TRDI.

2. Rinse with fresh water to remove soap or Lime-Away® residue.
3. Dry the transducer faces with low-pressure compressed air or soft lint-free towels.



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.

## Cleaning the Thermistor

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.



6000 meter systems have the thermistor embedded in the head. No maintenance is required.

### Clean the TRDI Thermistor

The TRDI thermistor is located in the transducer assembly under a stainless steel cover that is highly resistant to corrosion. Biofouling may build up around the cover, and eventually clog the sensor. To clean the sensor, wipe the temperature sensor cover with a clean soft cloth. Do not scratch or scrape the cover.

### Clean the Sea-Bird SBE38 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.



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

## Cleaning the Pressure Sensor Port

In order to read the water pressure, water must be able to flow through the cover on the pressure sensor. The tiny hole in the cover may at times be blocked. Use the following procedure and Figure 39 to clean the cover.



The Pressure Sensor is optional for DVS II systems ONLY. It may not be included on your system. Contact TRDI Sales for upgrade pricing.

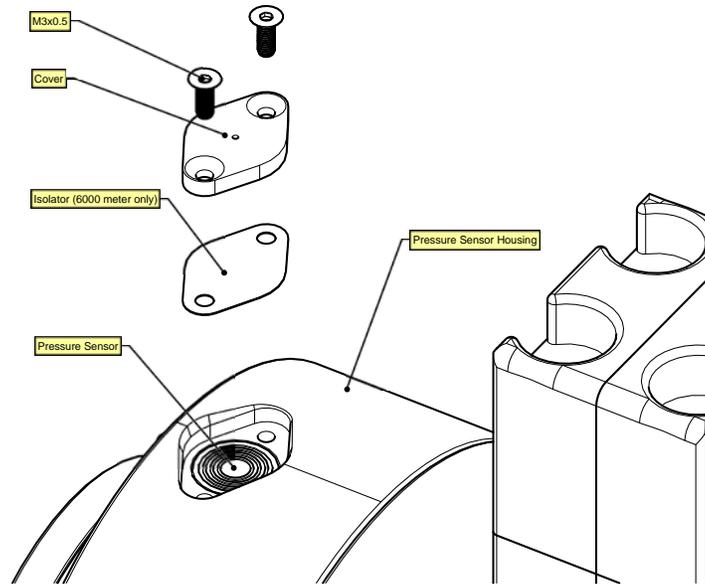


Figure 39. Pressure Sensor

To clean the pressure sensor port:

1. Place the DVS on a soft pad to protect the DVS.
2. Use a M3 hex key to remove the two nylon M3 screws.
3. Gently clean out the hole in the cover with a needle.



The pressure sensor is filled with silicone oil. Never poke a needle or other object through the cover while the cover is installed over the pressure sensor. You will perforate the sensor, causing it to fail.

Do not attempt to clean the surface of the pressure sensor. The diaphragm is very thin and easy to damage. If the pressure sensor surface looks corroded or is bowed outward, then contact TRDI for servicing.



The pressure sensor installed on the DVS is installed in a cavity that includes a protective cover to prevent particles from collecting on top of the pressure sensor itself. This cover is made of copper and is held into place with two M3 screws. The holes where the M3 screws are inserted in the 6000 meter pressure sensor housing are anodized aluminum.

TRDI knows from our experience that it is difficult to anodize sharp edges on threaded holes such as these. In marine and fresh water environments, poor anodizing on aluminum will lead to corrosion problems. **Always inspect for corrosion in this (and all) areas between deployments.**

4. On 6000 meter DVS systems:

- Look for signs of corrosion such as white deposits. If corrosion caused part of the pressure sensor housing to be visibly damaged, do not redeploy your system. Send it back to TRDI for inspection (see [Returning Systems to TRDI for Service](#)).
  - Clean both M3 screw mounting holes with a thin brush and lime based product. Flush the holes with the lime based product if you do not have a brush available. Be sure clean and remove any signs of corrosion.
  - Brush the M3 screws with marine environment grease such as Aqua Shield grease. Use gloves as it tends to stick to your skin. Note that the grease is incompressible and therefore apply a thin layer to the screws to avoid binding or difficulty in the installation of the screws in the mounting holes.
5. Install the Mylar isolator (6000 meters systems only) and copper cover. Tighten the screws “finger tight” 0.22 Nm (2 Pound-Force Inch). Do not over tighten the screws or you may strip the threads on the pressure sensor housing. If this happens, return the DVS to TRDI for repair.

## Inspecting the Zinc Anodes

High-pressure 6000 meter 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:

1. 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.
2. 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.
3. 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 multi-meter (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

To remove and replace the zinc anode/s:

1. Remove the RTV from the anode screw heads. Remove the screws.
2. 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.
3. 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.
4. Set a new anode in place and fasten with new screws.
5. 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.
6. Check electrical continuity between anodes on the end cap. If any measurement is greater than five ohms, reinstall the affected anode.



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.

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

## Repairing the Protective Coating Paint

TRDI uses paint on the 6000 meter DVS 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.



The procedures contained in this section apply to our standard aluminum systems. For systems made of other materials, contact TRDI. Read all instructions before doing the required actions.

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.



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.

If you are familiar with the repair of anodized coatings:

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 below.

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 the steps 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).

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.

# Replacing Boards in the DVS

Use this section to replace DVS boards in the field.

## Replacing the PIO, DSP, Personality Module Boards

This section explains how to replace the DSP, PIO, and Personality Module boards. Please refer to [Configuring the Newly Installed Boards](#) to finalize the upgrade.



This procedure can be used to replace all three boards or individual boards as necessary. The Personality Module is attached to the PIO board via a connector. The PIO and DSP boards are also connected to each other via a connector and will remain as one piece. All three boards must be removed together before an individual board can be replaced.

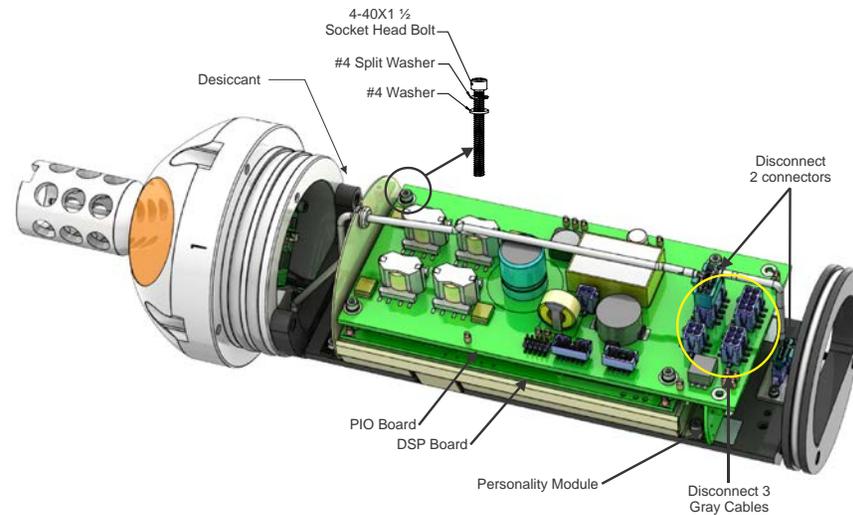
### Additional Equipment Required:

- ESD Safe Work Space
- Soft pad (ESD Safe) to rest DVS on while disassembling and reassembly
- Anti-static ground strap
- Hex wrenches
- Torque hex 3mm wrench to close-up housing
- Set of O-rings and Desiccant
- Plastic wedge (for 750 meter DVS transducer head removal)

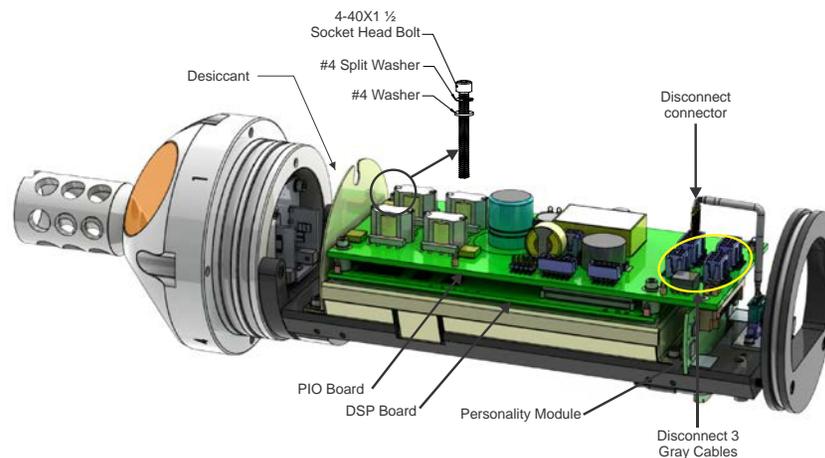
## Remove DSP, PIO, and Personality Module Boards

To remove the original DSP, PIO, and Personality Module boards:

1. Attach an earth-grounded wrist strap.
2. Remove the end-cap.
  - For 750 meter DVS systems, see [Removing the End-Cap – 750 Meter Housing](#).
  - For 6000 meter DVS systems, see [Removing the End-Cap – 6000 Meter Housing](#).
3. Remove the transducer head. The electronic chassis is attached to the transducer head assembly.
  - For 750 meter DVS systems, see [Removing the Transducer Head Assembly - 750 meter](#).
  - For 6000 meter DVS systems, see [Removing the Transducer Head Assembly – 6000 Meter](#).



**Figure 40. DVS Phase I Electronic Chassis (750 meter system shown)**



**Figure 41. DVS Phase II Electronic Chassis (750 meter system shown)**

4. Disconnect the two connectors on the light gray cable going across the top of the PIO board as shown in Figure 40. For Phase II DVS systems only disconnect the one connector (see Figure 41). Move the cable to the side.
5. Disconnect the three gray cables from the PIO board. These cables have a 4-pin, 6-pin, and 8-pin connectors to avoid confusion when reconnecting.



Please know that the connectors have a lock tab on the front of the connector. Squeeze the front of the connector to unlock the tab and pull straight up to remove each connector. They fit tightly, so some effort may be needed to remove them.

6. Remove the four 4-40 socket head screws / flat washers / split washers holding the DSP and PIO boards in place. The Personality Module is attached to the PIO board via a connector. The PIO and DSP boards are also connected to each other via a connector and will remain as one piece. Carefully lift the three boards up.
7. Remove the personality module from the PIO board connector.



Older DVS systems may have the personality module attached to the PIO board using two standoffs and two screws. If so, remove the two screws holding the board in place.

8. Set the original DSP, PIO, and Personality Module boards aside on an anti-static surface.



The original boards must be returned to TRDI. Please contact the Teledyne RD Instruments Customer Service Department for shipping instructions.

## Installing a New DSP, PIO, and Personality Module Board

To install a new DSP, PIO, and Personality Module board:

1. Connect the personality module to the PIO board. Check the connector between the PIO and personality module is fully seated.



Older DVS systems may have the personality module attached to the PIO board using two standoffs and two screws. If so, attach the module to the PIO board using the two standoffs and screws.

2. Ensure that all stand-offs are present on both the PIO and DSP boards. When connecting the PIO to the DSP board, check that all four PIO standoffs are in-line with the mounting holes and pressed between the PIO and the DSP boards.
3. Check the two connectors between the DSP and PIO board are fully seated.
4. Gently place the board stack on the electronic chassis. Align the personality module with its guiding slot on the base plate (see Figure 41).



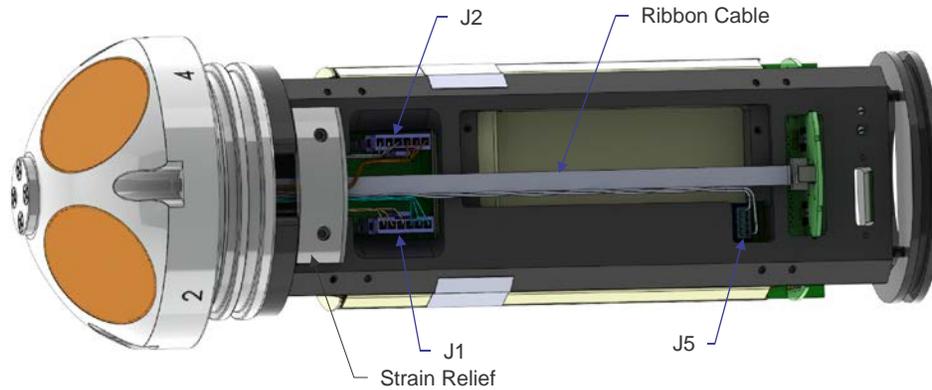
Use caution when placing the board stack on the chassis. Do not hit or bend the connector on the bottom of the DVS Phase II personality module (see Figure 42).

5. Align the DSP's (lower board) connectors with the Receiver board connectors before pressing down on the board stack. Press the DSP and PIO board stack onto the Receiver board connectors.



Do not use excessive force when pressing the DSP/PIO board stack onto the Receiver board. If you feel resistance, visually check the connection and try again. You should hear an audible "snap" when the connection is made.

6. Replace the four 4-40 socket head screws / flat washers / split washers holding the boards in place. Tighten the bolts to 0.45 Nm (4 Pound-Force Inch) using a torque wrench.
7. Reconnect the three gray cables (4 pin, a 6 pin, and an 8 pin connector) on the PIO board.
8. For DVS I systems, reconnect the connectors on light gray cable going across the top of the PIO board (see Figure 40). Make sure the cable strain relief is on the slot. For DVS II systems, connect the light gray cable connector to the PIO board (see Figure 41).
9. Connect the ribbon cable to the Personality Module (Figure 42). Check that the J1 and J2 cables are fully seated.



**Figure 42. Electronics Chassis Cables**

10. Install the transducer head in the housing.

- For 750 meter DVS systems, see [Installing the Transducer Head – 750 Meter](#).
- For 6000 meter DVS systems, see [Installing the Transducer Head – 6000 Meter](#).

11. Install the end-cap.

- For 750 meter DVS systems, see [Installing the End-Cap – 750 Meter](#).
- For 6000 meter DVS systems, see [Installing the End-Cap – 6000 Meter](#).

## Replacing the End Cap Interface Board

This section explains how to replace the End-Cap Interface board.

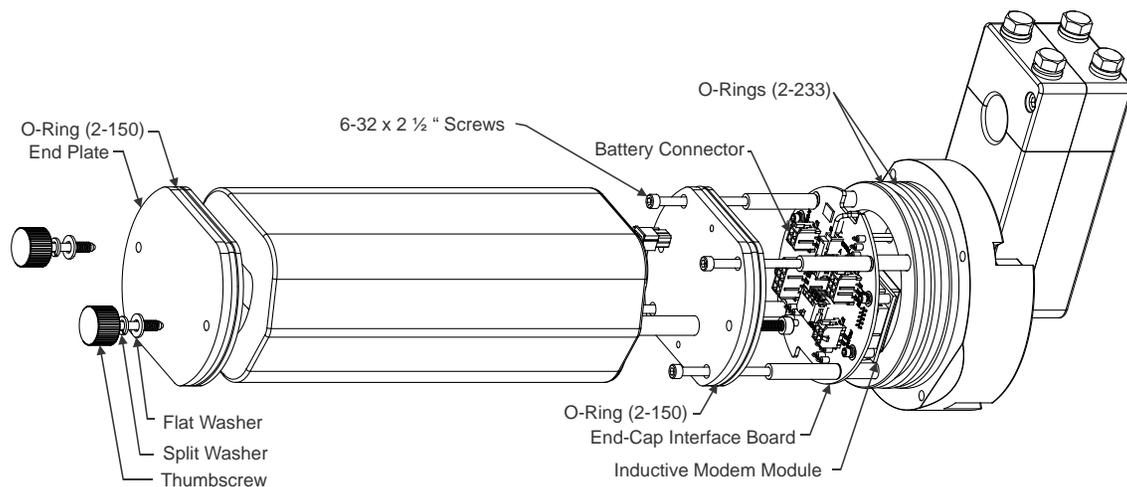
### Additional Equipment Required

- ESD Safe Work Space
- Soft pad (ESD Safe) to rest DVS on while disassembling and reassembly
- Anti-static ground strap
- Hex wrenches
- Set of O-rings and Desiccant

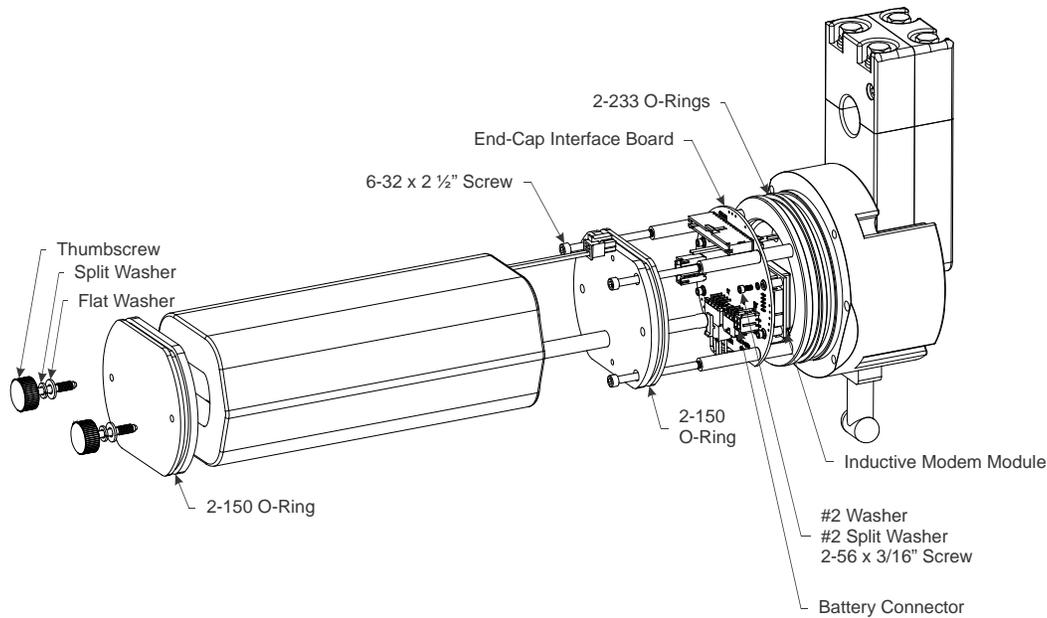
## Removing the End-Cap Interface Board

To remove the original End-Cap Interface board:

1. Attach an earth-grounded wrist strap.
2. Remove the end-cap.
  - For 750 meter DVS systems, see [Removing the End-Cap – 750 Meter Housing](#).
  - For 6000 meter DVS systems, see [Removing the End-Cap – 6000 Meter Housing](#).
3. Remove the battery pack. First disconnect the battery connector. Remove the end-plate by removing the two thumbscrews. Slide the battery pack out and set aside.
4. If your end-cap has an external connector, disconnect connector (J3 for Phase I DVS or PRIMARY I/O for DVS II) on the End-Cap Interface board.
5. Remove the four 6-32 socket head screws holding the End-Cap Interface board in place.
6. If your end-cap has an IMM, disconnect the 2-pin connector (J8 for Phase I DVS or INDUCTIVE MODEM COUPLER for DVS II) on the bottom of the End-Cap Interface board.
7. Remove the Inductive Modem Module from the end-cap interface board and mount it to the new interface board using the four 2-56 screws, split washers, and flat washers.



**Figure 43. End-Cap Interface Board (Phase I DVS)**



**Figure 44. End-Cap Interface Board (Phase II DVS)**

## Installing the New End-Cap Interface Board

Once the original board has been removed, install the new End-Cap Interface board.

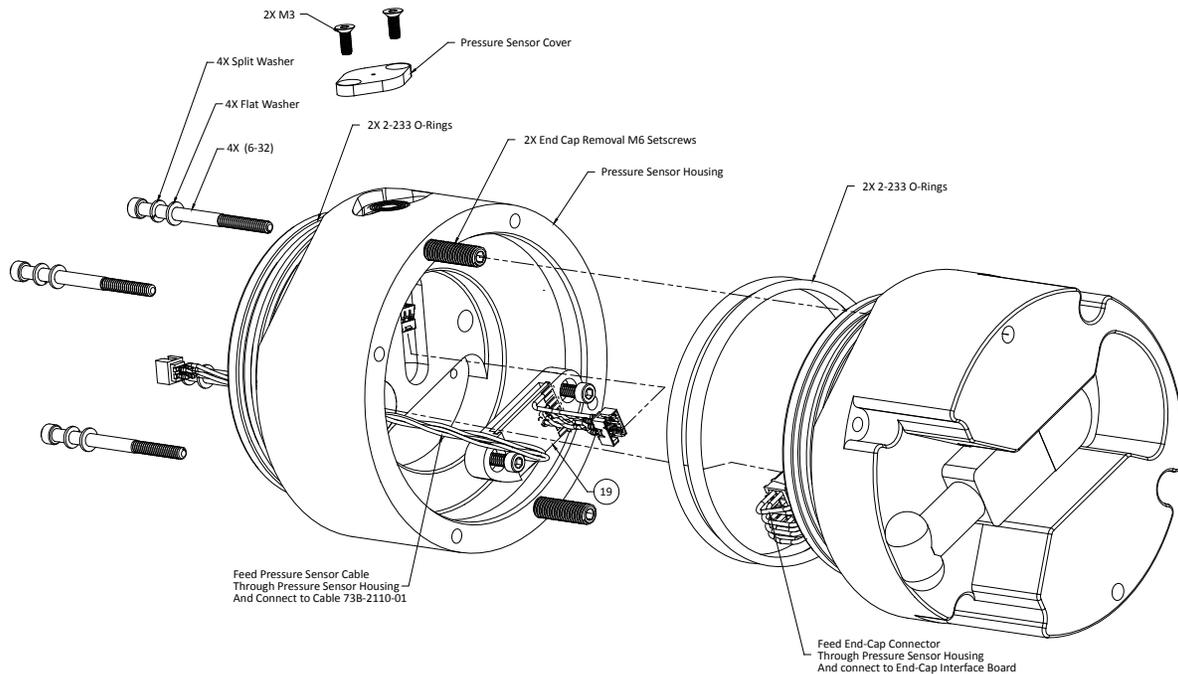
1. Ensure the four standoffs are pressed into the end-cap.
2. If your end-cap has an IMM, connect the 2-pin connector (J8 for Phase I DVS or INDUCTIVE MODEM COUPLER for DVS II) on the bottom of the End-Cap Interface board.
3. Place the End-Cap Interface board onto the standoffs. See Figure 43 and Figure 44 to orient the board correctly.
4. Replace the four 6-32 socket head screws holding the board in place. Tighten the bolts to 0.45 Nm (4 Pound-Force Inch) using a torque wrench.
5. Slide the battery pack onto the rails. Place the spacer and end-plate on top of the rails and tighten the two thumbscrews. Connect the Red/Black battery connector.
6. If your end-cap has an external connector, connect the cable (J3 for Phase I DVS or PRIMARY I/O for DVS II).
7. Install the end-cap.
  - For 750 meter DVS systems, see [Installing the End-Cap – 750 Meter](#).
  - For 6000 meter DVS systems, see [Installing the End-Cap – 6000 Meter](#).

# Installing the Pressure Sensor Upgrade

The pressure sensor field upgrade kit includes the parts necessary to add a pressure sensor to the DVS.

## Parts Included:

- Personality Module
- PIO to Sensors cable 73B-2110-01
- Pressure Sensor housing
- O-Rings

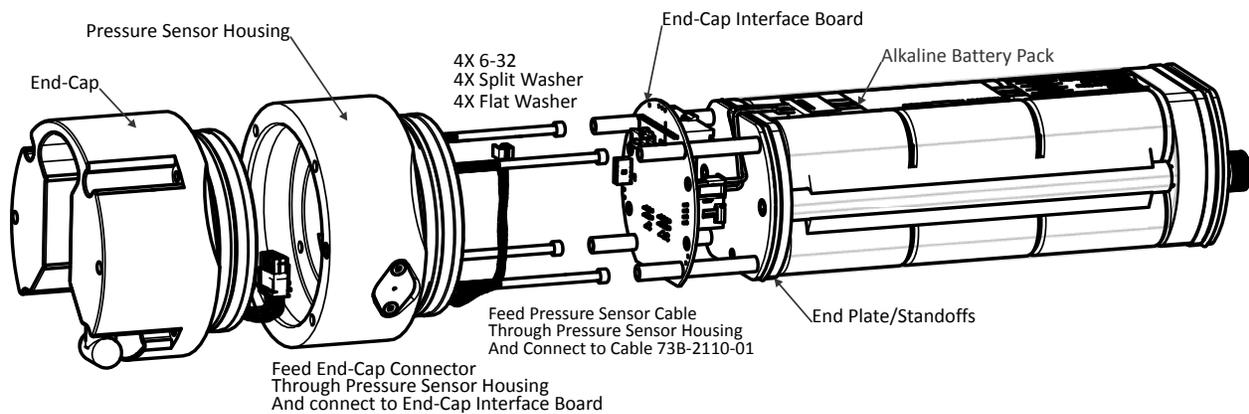


**Figure 45. Pressure Sensor Assembly (750 meter DVS)**

To install the pressure sensor:

1. Attach an earth-grounded wrist strap.
2. Remove the end-cap.
  - For 750 meter DVS systems, see [Removing the End-Cap – 750 Meter Housing](#).
  - For 6000 meter DVS systems, see [Removing the End-Cap – 6000 Meter Housing](#).
3. Remove the transducer head. The electronic chassis is attached to the transducer head assembly.
  - For 750 meter DVS systems, see [Removing the Transducer Head Assembly - 750 meter](#).
  - For 6000 meter DVS systems, see [Removing the Transducer Head Assembly – 6000 Meter](#).
4. Remove the DSP, PIO, and Personality Module, see [Replacing the PIO, DSP, Personality Module Boards](#).
5. Replace the Personality Module with the new board.
6. Replace the 73B-2110-00 cable with the new 73B-2110-01 cable.

7. Remove the battery, stand-offs, and end-cap interface board from the end-cap (see [Replacing the End Cap Interface Board](#)).
8. Install the O-rings on the pressure sensor housing.
9. Feed the end-cap connector and pressure sensor cables through the pressure sensor housing.
10. Install the end-cap onto the pressure sensor housing using the four 6-32 screws. Torque the screws to 0.9 Nm (8 Pound-Force Inch).
11. Move the battery, stand-offs, and end-cap interface board to the pressure sensor housing.
12. Install the transducer head in the housing.
  - For 750 meter DVS systems, see [Installing the Transducer Head – 750 Meter](#).
  - For 6000 meter DVS systems, see [Installing the Transducer Head – 6000 Meter](#).
13. Install the end-cap.
  - For 750 meter DVS systems, see [Installing the End-Cap – 750 Meter](#).
  - For 6000 meter DVS systems, see [Installing the End-Cap – 6000 Meter](#).



# Chapter 4

## TESTING THE DVS



In this chapter, you will learn:

- Testing the DVS
- Verify/Set temperature and HPR sensor
- Short deployment test
- Configuring newly installed boards

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 troubleshooting information, see [Troubleshooting](#).

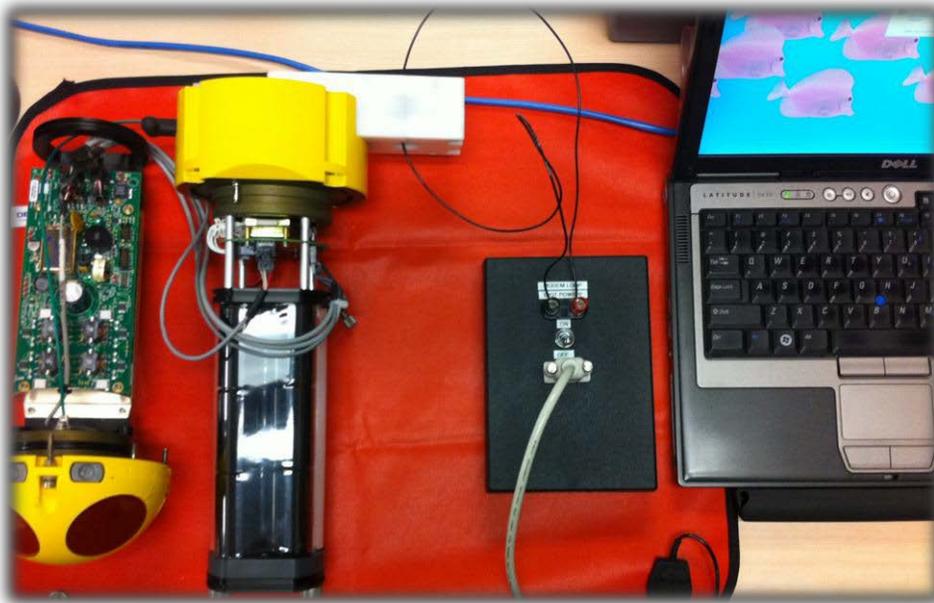


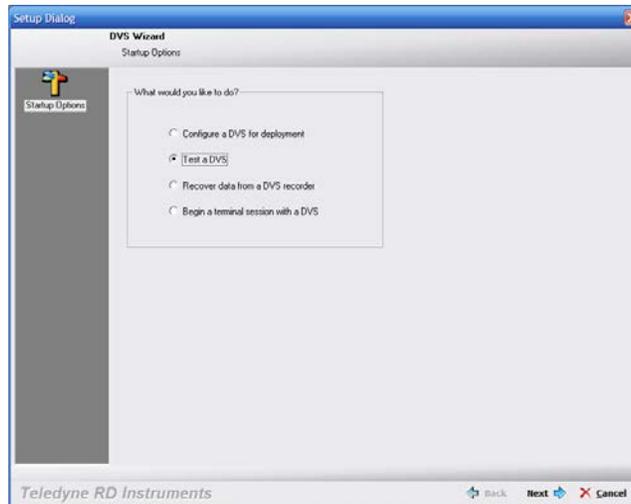
Figure 46. IMM Surface Inductive Modem TRDI Field Test Box

## Running the DVS Built-In Tests

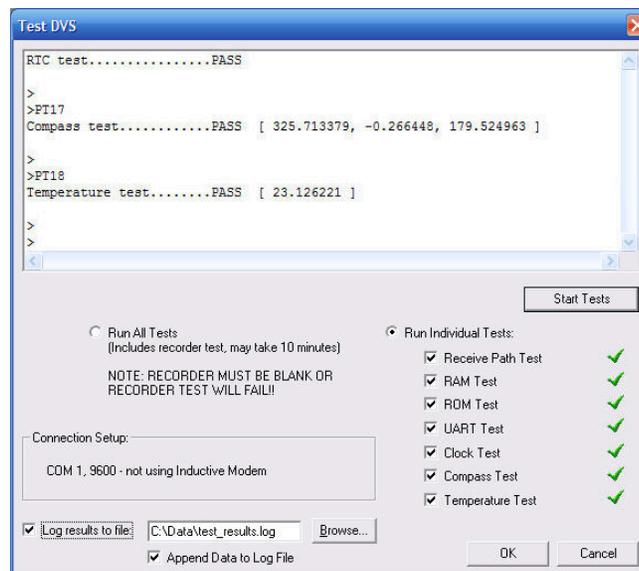
This simple test checks that the DVS is able to communicate with the computer and runs the diagnostic tests.

To run the Built-In Tests:

1. Connect and power up the DVS as shown in [Set Up the DVS](#).
2. Start the *DVS* software.
3. At the **DVS Wizard Startup Options** screen, click **Test a DVS**. Click **Next**.



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



- The results of the test will be saved to the log file (\*.log) if the **Log result to file** box is selected.
- Click the **Start Test** button. The selected tests will run (see the DVS Operation Manual for details on the test printouts). A green check mark next to the test name indicates the test passed. If a selected test fails, a red **X** will be placed next to the test name and a dialog box will prompt if you want to continue testing.
- Click **OK** to exit the **Test DVS** screen.



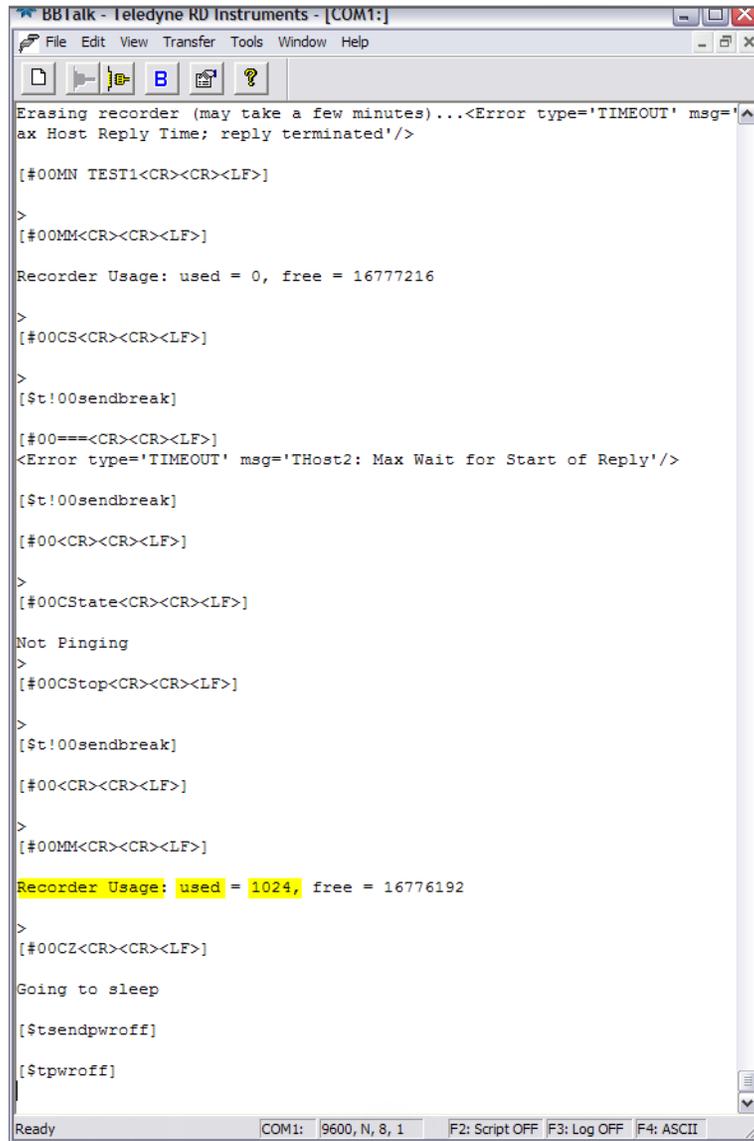
These tests should be run in the deployed environment to achieve good results.

# Short Deployment Test

This test will deploy the DVS in air for a fixed period of time. The goal is to verify that the file size of the resulting data file is correct and that data can be displayed in *WinADCP* after being converted from the DVS reduced format PD20 to WorkHorse ADCP standard PDO format.

To deploy the DVS:

1. Open a new text file with Windows® Notepad (  ).
2. Copy [CTRL+C] and then Paste [CTRL+V] all the commands provided in the [Test Script](#) into this text file.
3. Save the file as *Test\_IMM\_DVS\_PostUpgrade.txt*.
4. Connect the Surface Modem Test Box to your computer.
5. Loop a conductor through the DVS inductive modem and the surface inductive modem (not supplied) connected to a computer. Power can be supplied either from the battery pack or from an external supply via the test cable. If the DVS is sealed for deployment, then power must be supplied from the battery pack.
6. Run *BBTalk*.
7. Select 9600bds.
8. Enable **Echo Characters** option.
9. Switch the Surface IMM Power switch ON.
10. Press **F2** on your keyboard and select the Script file you have just created *Test\_IMM\_DVS\_PostUpgrade.txt*.
11. Click **OK**.
12. The script file will run for about 10minutes. In the bottom right corner of *BBTalk* the **F2:SCRIPT** text will be blinking for as long as the script is running. As a result the DVS will deploy itself for a few seconds. You will need to:
  - Verify the size of the obtained file is 1024bytes. Look for this line close to the end of the script:
  - At the end of the script, the **F2:SCRIPT** text will stop blinking. At that point you will need to go to the next step.

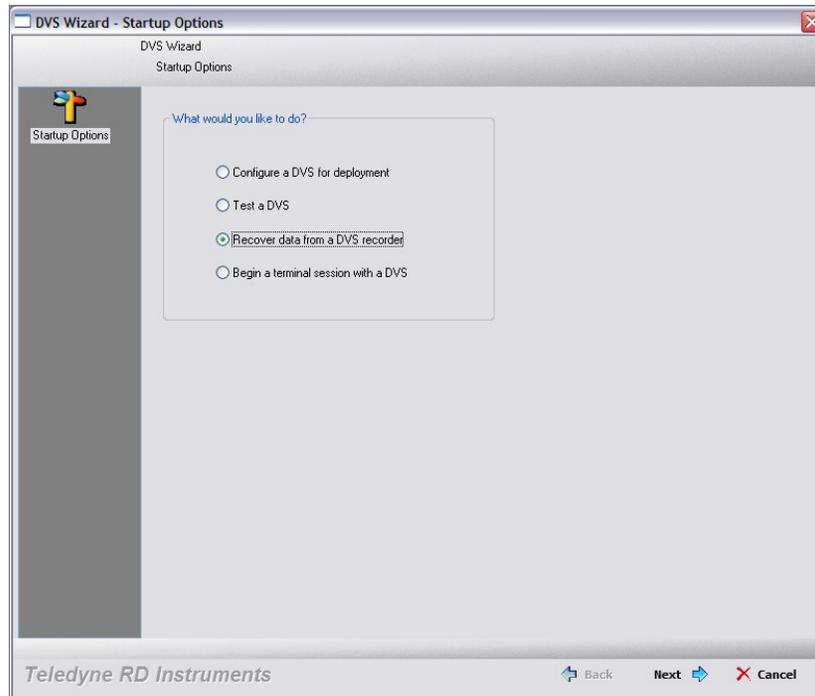


```
BBTalk - Teledyne RD Instruments - [COM1:]
File Edit View Transfer Tools Window Help
Erasing recorder (may take a few minutes)...<Error type='TIMEOUT' msg='Max Host Reply Time; reply terminated' />
[#00MN TEST1<CR><CR><LF>]
>
[#00MM<CR><CR><LF>]
Recorder Usage: used = 0, free = 16777216
>
[#00CS<CR><CR><LF>]
>
[!00sendbreak]
[#00===<CR><CR><LF>]
<Error type='TIMEOUT' msg='THost2: Max Wait for Start of Reply' />
[!00sendbreak]
[#00<CR><CR><LF>]
>
[#00CState<CR><CR><LF>]
Not Pinging
>
[#00CStop<CR><CR><LF>]
>
[!00sendbreak]
[#00<CR><CR><LF>]
>
[#00MM<CR><CR><LF>]
Recorder Usage: used = 1024, free = 16776192
>
[#00CZ<CR><CR><LF>]
Going to sleep
[!00sendpwoff]
[!00pwoff]
Ready COM1: 9600, N, 8, 1 F2: Script OFF F3: Log OFF F4: ASCII
```

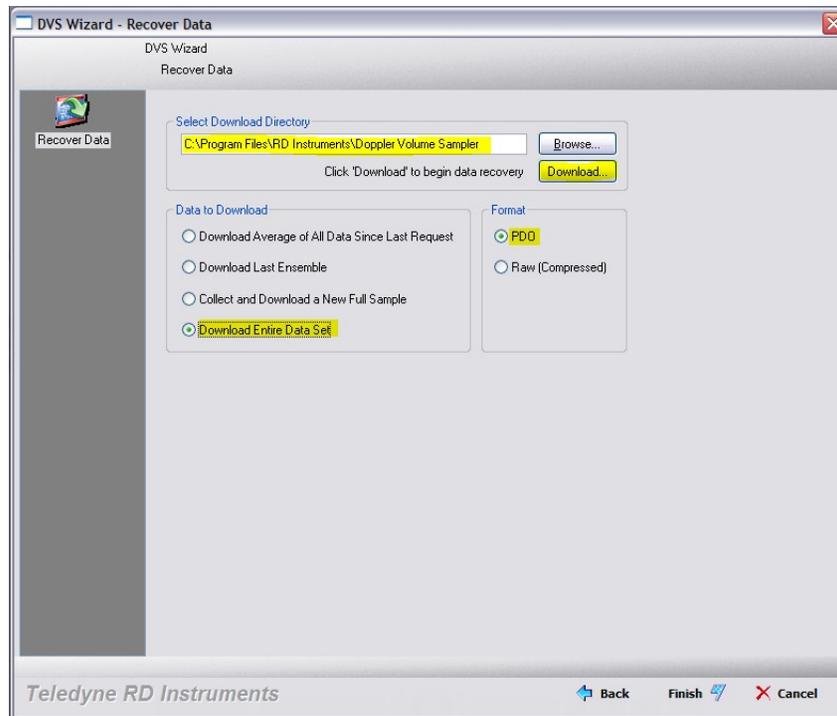
13. Close *BBTalk*.

14. Run your *DVS* software.

15. At the wizard, select **Recover Data from DVS recorder** and Click **NEXT**.

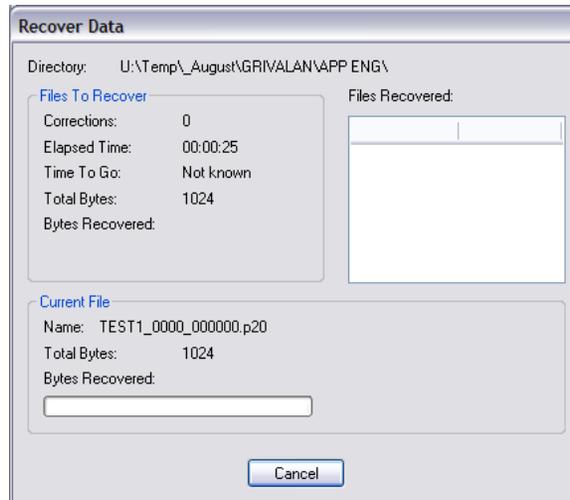


16. At the next page, select the target directory where to save the recovered file + Select **PDO** output format + Select **Download Entire Data Set**:

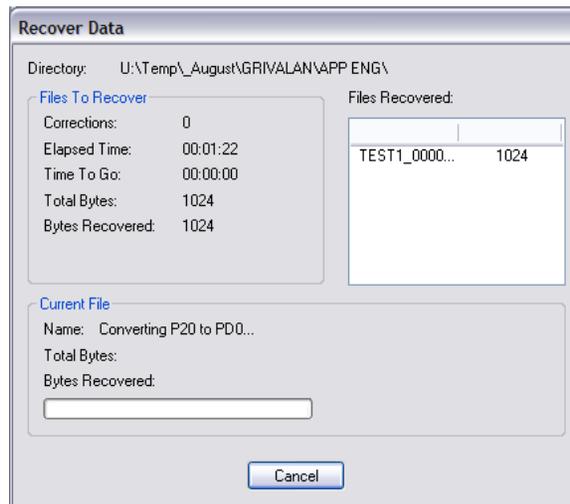


17. Click the **Download** button.

18. The following window will open, and the download will start.



19. Then the software will start converting the PD20 file into a PDO file.

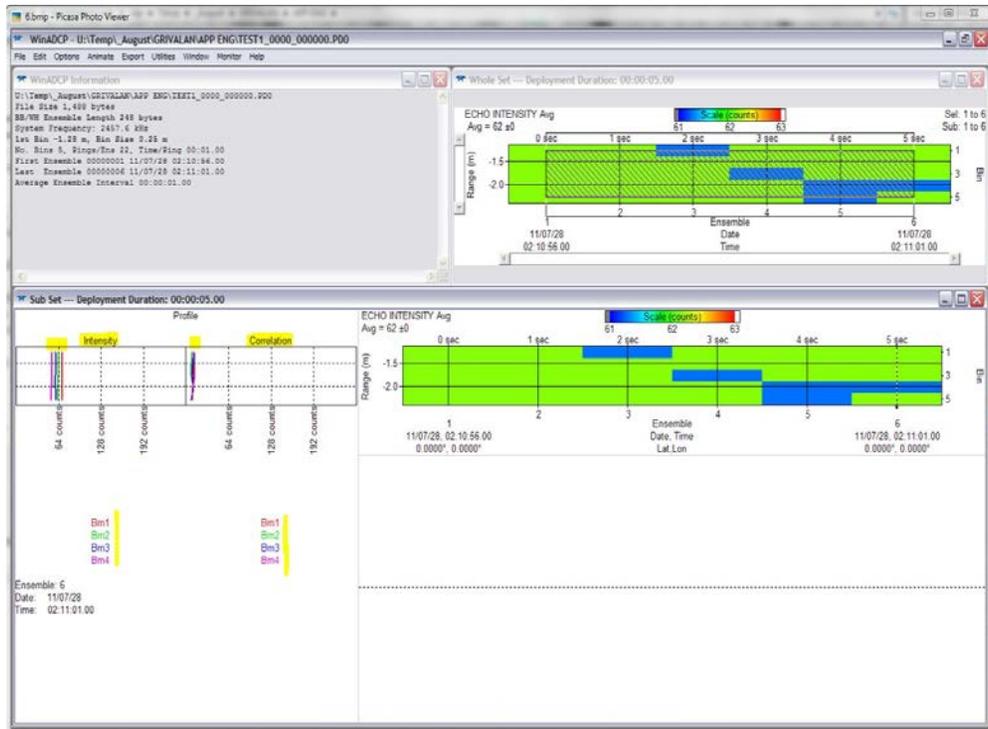


20. The process is complete, Click **OK**.



21. Run *WinADCP* and open the file named *TEST1\_0000\_000000.PDO*.

22. Verify that you can read the four beams correlation and intensity in either the profile area or the contour area:



23. If all was verified then the DVS is ready for deployment, you should now run your DVS software as usual and setup your DVS for its next deployment.



Before deploying your DVS please make sure to install a fresh new battery. Testing can drain the battery considerably which may result in a shorter deployment period than planned with the DVS software planning wizard.

# Configuring Newly Installed Boards

Use this procedure if you have just replaced the PIO or DSP boards.

To configure the new boards:

1. Connect and power up the DVS as shown in [Inductive Modem Setup](#).
2. Open a new text file with Windows® Notepad ()
3. Copy [**CTRL+C**] and then Paste [**CTRL+V**] all the commands provided in the [test scripts](#) into this text file.
4. Save the file as *Test\_IMM\_DVS\_PostUpgrade.txt*.
5. Connect the Surface Modem Test Box to your computer.
6. Loop a conductor through the DVS inductive modem and the surface inductive modem (not supplied) connected to a computer. Power can be supplied either from the battery pack or from an external supply via the test cable. If the DVS is sealed for deployment, then power must be supplied from the battery pack.
7. Run *BBTalk*.
8. Select 9600 bds.
9. Enable **Echo Characters** option.
10. Switch the Surface IMM Power switch ON.
11. Press **F2** on your keyboard and select the Script file you have just created *Test\_IMM\_DVS\_PostUpgrade.txt*.
12. Click **OK**.

## Test Scripts

These script files were created assuming that the DVS DeviceID is 00. If the DeviceID is 99, then replace all the highlighted 00 with 99.

For example, line 14 and 15 will become:

```
$P$t!99sendbreak  
$t!99sendbreak
```

Note that the number 3030 is highlighted in the script: 00 ASCII is 3030 Hex. If the DeviceID is 99 then replace it with 3939 (99 ASCII is 3939 Hex).

For example, line 17 and 18 will become:

```
$P#99CState<CR><CR><LF>  
$S2339394353746174650D0D0A
```



To determine the DeviceID of your DVS, send the following commands in *BBTalk* (version 3.08 and greater):

```
forcecaptureline^m^j  
forcecaptureline^m^j  
id?^m^j
```

## Script File – DVS with TRDI Temperature Sensor

```

$Pforcecaptureline<CR><LF>
$S666f726365636170747572656c696e650D0A
$D5
$Pforcecaptureline<CR><LF>
$S666f726365636170747572656c696e650D0A
$D5
$tforcecaptureline
$D5
$tforcecaptureline
$D5
$P#00<CR><CR><LF>
$S2330300D0D0A
$D2.5
$P$t!00sendbreak
$t!00sendbreak
$D2.5
$P#00CState<CR><CR><LF>
$S2330304353746174650D0D0A
$D5
$P#00CStop<CR><CR><LF>
$S2330304353746f700D0D0A
$D5
$P$t!00sendbreak
$t!00sendbreak
$D2.5
$P#00<CR><CR><LF>
$S2330300D0D0A
$D2.5
$P#00CR1<CR><CR><LF>
$S2330304352310D0D0A
$D2.5
$P#00@C<CR><CR><LF>
$S23303040430D0D0A
$D7
$P#00N1234<CR><CR><LF>
$S2330304E313233340D0D0A
$D5
$P#00T<CR><CR><LF>
$S233030540D0D0A
$D5
$P#001<CR><CR><LF>
$S233030310D0D0A
$D5
$P#001<CR><CR><LF>
$S233030310D0D0A
$D5
$P$t!00sendbreak
$t!00sendbreak
$D2.5
$P#00<CR><CR><LF>
$S2330300D0D0A
$D2.5
$P$t!00sendbreak
$t!00sendbreak
$D2.5
$P#00CR1<CR><CR><LF>
$S2330304352310D0D0A
$D3
$P#00CZ<CR><CR><LF>
$S233030435A0D0D0A
$D2.5
$P$tsendpwoff
$tsendpwoff
$D2.5
$P$tppwoff
$tpwoff

```

## Script File – DVS with Sea-Bird Temperature Sensor

```

$Pforcecaptureline<CR><LF>
$S666f726365636170747572656c696e650D0A
$D5
$Pforcecaptureline<CR><LF>
$S666f726365636170747572656c696e650D0A
$D5
$tforcecaptureline
$D5
$tforcecaptureline
$D5
$P#00<CR><CR><LF>
$S2330300D0D0A
$D2.5
$P$t!00sendbreak
$t!00sendbreak
$D2.5
$P#00CState<CR><CR><LF>
$S2330304353746174650D0D0A
$D5
$P#00CStop<CR><CR><LF>
$S2330304353746f700D0D0A
$D5
$P$t!00sendbreak
$t!00sendbreak
$D2.5
$P#00<CR><CR><LF>
$S2330300D0D0A
$D2.5
$P#00CR1<CR><CR><LF>
$S2330304352310D0D0A
$D2.5
$P#00@C<CR><CR><LF>
$S23303040430D0D0A
$D7
$P#00N1234<CR><CR><LF>
$S2330304E313233340D0D0A
$D5
$P#00T<CR><CR><LF>
$S233030540D0D0A
$D5
$P#002<CR><CR><LF>
$S233030320D0D0A
$D5
$P#001<CR><CR><LF>
$S233030310D0D0A
$D5
$P$t!00sendbreak
$t!00sendbreak
$D2.5
$P#00<CR><CR><LF>
$S2330300D0D0A
$D2.5
$P$t!00sendbreak
$t!00sendbreak
$D2.5
$P#00CR1<CR><CR><LF>
$S2330304352310D0D0A
$D3
$P#00CZ<CR><CR><LF>
$S233030435A0D0D0A
$D2.5
$P$tsendpwoff
$tsendpwoff
$D2.5
$P$tppwoff
$tpwoff

```

# Chapter 5

## TROUBLESHOOTING THE DVS



In this chapter, you will learn:

- Basic steps in troubleshooting
- Troubleshooting communication failures
- Troubleshooting a built-in test failure
- Troubleshooting a beam failure
- Troubleshooting data problems

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.

**Table 4: List of Least Replaceable Assemblies**

LRA	Description
DVS	The entire DVS; includes the electronics, housing, transducer ceramic assemblies, and end-cap.
I/O 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.

## Equipment Required

Special test equipment is not needed for trouble shooting and fault isolation. The equipment is listed in Table 5. Any equipment satisfying the critical specification listed may be used.

**Table 5: Required Test Equipment**

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%
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.



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

# 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.

## 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 4). Before troubleshooting, review the procedures, figures, and tables in this guide. Also, read the [System Overview](#) to understand how the DVS processes data.



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

# Troubleshooting Safety

Follow all safety rules while troubleshooting.



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



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.



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.



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



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.



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.



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

# Troubleshooting a Communication Failure

DVS units communicate by means of RS-232, RS-422, or the inductive modem.

To successfully communicate, both the host computer and the DVS must communicate using the same class of serial interface. RS-232 is a standard serial interface for IBM-compatible computers.

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.

## 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.

## 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 [Set Up the DVS](#). 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 (10.5 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.

## 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 +10.5 to 28 VDC (using an external power supply).

## Check the I/O Cable

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

1. Disconnect both ends of the cable and measure the continuity using a DMM (see [DVS Cables](#) for the wiring diagram). Correct any problems found.
2. Reconnect the I/O cable to host computer.
3. Start the *DVS* program on your computer. Select the proper communications port (see the *DVS Software User's Guide* for help on using *DVS*).
4. Short TX1A and RX1A together on the cable connector that was plugged into the DVS (see [DVS Cables](#)).
5. 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.
6. 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](#).



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

## 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 Dis-assembly](#)). Check for any loose cables. Contact our field service for further troubleshooting (see [Technical Support](#)).

## Verifying Modem Communications

This section will describe how to verify that communications between the PC and the surface IMM, the DVS IMM, and the DVS itself are configured and working correctly. There are three verification steps described below. These steps can be helpful in trouble-shooting communication problems.



For a complete listing of IMM commands and functions, please refer to Sea-Bird's IMM User Manual.



The steps described in this section utilize either TRDI's *BBTalk* program or the *HyperTerminal* application, which is installed by default on *Windows* operating system.

1. To launch *BBTalk*, go to **Programs, RD Instruments, BBTalk**. To launch *HyperTerminal*, go to **Start, Programs, Accessories, Communications, HyperTerminal**.
2. In *BBTalk* or *HyperTerminal*, 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).

3. Because the *DVS* software configures the modems to not echo back typed characters, set *BBTalk* or *HyperTerminal* to echo back the characters you type locally.
  - In *BBTalk*, under **Options** check **echo characters**.
  - In *HyperTerminal*, to enable this setting, select **File, Properties**. Click the **Settings** tab and then click the **ASCII Setup** button. Within the **ASCII Sending** section, check the **Echo typed characters locally** box, and click **OK** to save.
4. Click **OK** again to save close the properties dialog.

## Verify Communication with Surface IMM

To verify that you can communicate with the surface IMM from *BBTalk* or *HyperTerminal*, type the following command into the 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>
```



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.

## 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
```



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>
```



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.

## 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 *BBTalk* or *HyperTerminal*:

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



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

The first sendbreak 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 *BBTalk* or *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
O ----- Features
P ----- Performance Test Commands
S ----- Sensor Control
T ----- Time Commands
W ----- Water Profiling Commands
Y ----- Display Banner
? ----- 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.

If the following error is displayed while utilizing the “#” commands to communicate with the instrument:

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

Try recapturing the line with forcecapture line, followed by a soft break, and then the command. For example:

```
IMM>#01cstate<ctrl-M><ctrl-M><ctrl-J>
<Error type='TIMEOUT' msg='THost2: Max Wait for Start of Reply' />
IMM>!01sendbreak<ctrl-M><ctrl-J>
IMM>#01cstate<ctrl-M><ctrl-M><ctrl-J>
Pinging
```

## 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. Please ensure that you have firmware version 1.05 or later.

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.

## DVS IMM Settings



Please note that commands used to communicate with the DVS IMM are preceded by !xx (xx denoting the device ID).

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.

## DVS IMM Timeouts

**THost2:** Adjustable timeout for the start of the DVS-to-IMM reply to a command (range = 1 to 30 seconds). If this timeout occurs, the IMM sends an error message to the topside modem. The THost2 parameter can be set via the "SetTHost2=" command, and that command can be sent either from the topside modem, or from the DVS (e.g. when using a pass-through terminal mode to talk directly to the IMM from the command port). The THost2 parameter is set by the DVS software to 100 (i.e. one second). The current values can be viewed by sending the "!xxgetcd" command to the topside modem after sending the forcecaptureline command.

**THost3:** Maximum reply timeout for a DVS-to-IMM reply to a command (range = 1 to 180 seconds). Measured from the arrival of the command at the IMM (from the topside modem) to the termination of the IMM's transmission of the DVS reply. If this timeout occurs, the DVS reply is cut off, plus any remaining data in the IMM buffer is discarded, and an error is sent to the topside modem.

**THost4:** Inter-character-delay timeout for a DVS-to-IMM reply to a command (range = 50 ms to 30 seconds). If this timeout occurs, the reply from the DVS is cut off.

# 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.

## 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)
```



Always run the PT3 test with unit transducer beams submerged in standing (not moving) 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.

## 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.

# Troubleshooting Data Problems

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

## 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?
```

## 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.

## 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.

## DVS Cables

This section has information on DVS cabling. Custom configurations 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.

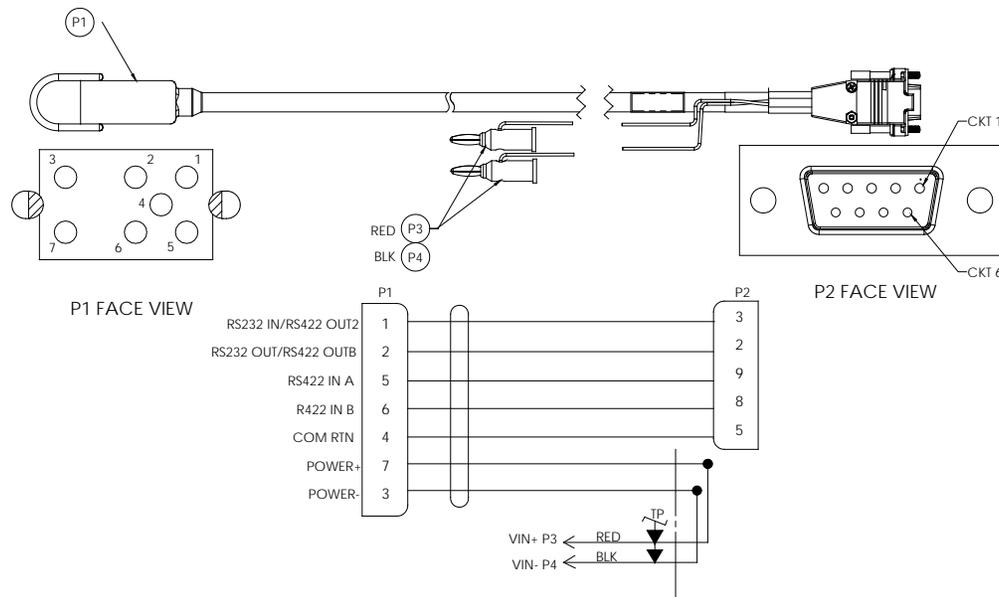


Figure 47. Test Cable Wiring (73B-6023-005)

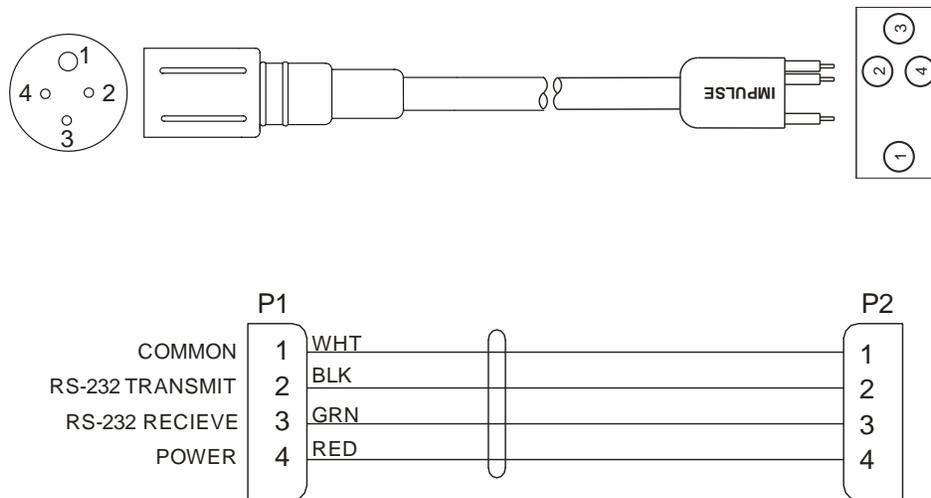


Figure 48. Sea-Bird SBE 37-SMP CTD Cable (73B-2014-00)

## System Overview

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

## Operating Modes

There are three main operational modes in the DVS: Command, Autonomous, and Polled.

### Command Mode

The Command Mode refers to the DVS in pre- or post-deployment state. In this mode the user may change deployment setup, install features, perform diagnostic testing and compass calibrations, and initiate data collection.

### Autonomous Mode

This simply describes the collection and storage of data at pre-programmed intervals.

#### *Polled Mode*

When the DVS has RS-232, RS-422 or inductive modem communications enabled, it may send an ensemble on request during a deployment without interrupting the deployment setup. There are three categories of polled mode: *Collect One Ensemble*, *Collect Average*, and *Collect Last Ensemble*.

- *Collect One Ensemble* corresponds to the [CO command](#) and the **Collect and Download a New Ensemble** option in the DVS software. The ensemble collected *is not* stored in flash memory. If a polled ping request interferes with pre-programmed collection, pre-programmed collection has precedence, and the polled request will be rejected.
- *Collect Average* sends the average of ensembles collected since the last polling request. Data are not lost – all data are stored in flash memory, regardless of inclusion in the requested ensembles. Collect Average corresponds to the [CV command](#) and to **Download Average of all Data Since Last Request** option in the DVS software.

- *Collect Last Ensemble* corresponds to the [CW command](#) and to **Download Last Ensemble** option in the DVS software. Only the last stored ensemble is output. Like Collect Average, data are not lost.

The DVS was designed to provide a high-degree of deployment flexibility and diagnostic capability. As such, the instrument operates seamlessly between Autonomous Mode and any variation of Polled Mode. Polling commands may be sent and executed without interrupting data collection.

## 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).

## Functional Description of Operation

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

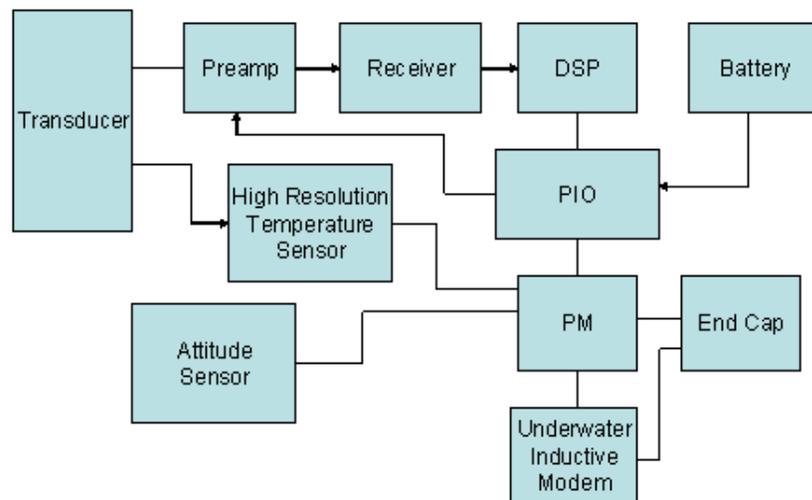


Figure 49. DVS Block Diagram

### **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 through 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:**

TRDI's Integrated Sensor Module (ISM) provides Heading, Pitch, and Roll data to the DVS.

**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 RS-232 or RS-422 serial port and a DC input. Optional end cap configurations include inductive modem and CTD capability.

# Chapter 6

## RETURNING SYSTEMS TO TRDI FOR SERVICE



In this chapter, you will learn:

- How to pack and ship the DVS
- How to get a RMA number
- Where to send your DVS for repair

# Shipping the DVS

This section explains how to ship the DVS.



Remove all customer-applied coatings or provide certification that the coating is nontoxic if you are shipping a DVS to TRDI for repair or upgrade. This certification must include the name of a contact person who is knowledgeable about the coating, the name, manufacturer of the coating and the appropriate telephone numbers. If you return the equipment without meeting these conditions, TRDI has 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 so identifying labels are not covered and can be seen easily by the Customs Inspector. Failure to do so could delay transit time.



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

If you need to ship 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:

1. Use a strong shipping container made out of wood or plastic.
2. 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.
3. Seal the shipping container securely.
4. Mark the container FRAGILE to ensure careful handling.
5. In any correspondence, refer to the DVS by model and serial number.

# Returning Systems to the TRDI Factory

When shipping the system 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.

## Step 1 - Request a Return Material Authorization

To obtain a Return Material Authorization (RMA) number and shipping instructions for the return of your instrument, do one of the following:

- Open the RMA using the web link: <http://adcp.com/support/sendADCP.aspx>
- Contact Customer Service Administration at [rdicsadmin@teledyne.com](mailto:rdicsadmin@teledyne.com)
- Call +1 (858) 842-2600

When requesting a RMA number, please give us the following information:

- What is being shipped (include the serial number)
- When you plan to send the shipment
- What issue(s) need to be corrected
- Name of the Field Service Engineer that knows about the issue
- When you need the instrument returned

TRDI's Customer Service will then respond with the RMA number for the shipment. Please include this number on all packages and correspondence.

## Step 2 – Provide a MSDS as necessary

Please provide a Material Safety Data Sheet (MSDS) if the system/transducer is painted with antifouling paint.

## Step 3 - Ship via air freight, prepaid

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

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

Mark the Package(s)

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

Airport of Destination = San Diego  
Notify Paxton, Shreve and Hayes

Phone: +1 (619) 232-8941  
Fax: +1 (619) 232-8976

#### Step 4 - Urgent shipments

Send the following information by fax or telephone to TRDI.

Attention: Customer Service Administration

Fax: +1 (858) 842-2822

Phone: +1 (858) 842-2600

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

## Returning Systems to TRDI Europe Factory

When shipping the system to TRDI Europe, the following instructions will help ensure the DVS arrives with the minimum possible delay. Any deviation from these instructions increases the potential for delay.

#### Step 1 - Request a Return Material Authorization

To obtain a Return Material Authorization (RMA) number and shipping instructions for the return of your instrument, do one of the following:

- Open the RMA using the web link: <http://adcp.com/support/sendADCP.aspx>
- Contact Customer Service Administration at [rdiefs@teledyne.com](mailto:rdiefs@teledyne.com)
- Call +33(0) 492-110-930

When requesting a RMA number, please give us the following information:

- What is being shipped (include the serial number)
- When you plan to send the shipment
- What issue(s) need to be corrected
- Name of the Field Service Engineer that knows about the issue
- When you need the instrument returned

TRDI's Customer Service will then respond with the RMA number for the shipment. Please include this number on all packages and correspondence.

#### Step 2 – Provide a MSDS as necessary

Please provide a Material Safety Data Sheet (MSDS) if the system/transducer is painted with antifouling paint.

#### Step 3 - Ship Via Air Freight, Prepaid

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

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

Mark the package(s) as follows:

To: Teledyne RD Instruments, Inc. (RMA Number)  
2A Les Nertieres  
5 Avenue Hector Pintus

06610 La Gaude, France

#### **Step 4 - Include Proper Customs Documentation**

The Customs statement must be completed. It should be accurate and truthfully contain the following information.

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

#### **Step 5 - Send the Following Information by Fax or Telephone to TRDI**

Attention: Sales Administration

Phone: +33(0) 492-110-930

Fax: +33(0) 492-110-931

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

NOTES

# Chapter 7

## SPECIFICATIONS



In this chapter, you will learn:

- What are the DVS specifications
- DVS dimensions and weights

# Specifications

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



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 sensor 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.

**Table 6: Physical Specifications**

<b>Physical:</b>	
Weight-in-air	See outline installation drawings
Weight in water	See outline installation drawings
Maximum Dimensions L x W	651x102 mm
<b>4 Bean Janus Transducer:</b>	
Frequency	2457.6 kHz
Beam width, two-way	0.65 deg. (typical)
Number of beams	4
Beam angle	45 deg.
Bandwidth	> 25%
<b>Recorder:</b>	
Flash Memory	16 MB
<b>Real Time Clock:</b>	
Accuracy	+/- 20 ppm
Resolution	0.01 sec.

**Table 7: Power Specifications**

<b>Power:</b>	
Input Voltage Range	10.5 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, Voltage	Alkaline, 18 VDC
Battery Shelf Life	Use within one year.
<b>Transmit:</b>	
XMIT Duty Cycle	35% (typ)
XMIT Power Beam @ 18 V	1.8 W (750m); 5W (6000m)



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 8: Environmental Specifications**

<b>Environmental:</b>	
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 9: Interface Specifications**

<b>User Interface:</b>	
Serial Communication Options	RS-232, RS-422, Inductive Modem Module
Serial Baud Rates	1200 to 115200 bps 9600 bps maximum for the inductive modem
Serial Data Formats	Binary and Hex-ASCII PD0/PD20
System Control	Set of commands sent via serial interface and supporting software
<b>Underwater Inductive MODEM:</b>	
Serial Communication Options	9600 baud default (See Sea-Bird IMM User Manual for detailed specifications)
<b>Software:</b>	
OS	Windows 2000, XP
Included Programs	<i>DVS, WinADCP and RDI Tools</i>

**Table 10: Velocity Specifications**

Velocity Measurement, BB	
Velocity Range	+/- 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	0.3 m
Profiling Range: 35 ppt, 10 deg. C, 18V, bin = 0.25m	3 m (typ)
Ping rate	Bin size dependent up to 40 Hz* *Over 40 Hz is possible without sampling heading pitch and roll. Approximately 14 Hz ping rate is possible when sensors are sampled.

**Table 11: Echo Intensity Specifications**

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

**Table 12: Sensor Specifications**

Temperature (TRDI):	
Range	-4 to 45 deg. C
Accuracy	+/- 0.5 deg. C (typical)
Precision	0.5 deg. C
Resolution	0.5 deg. C
High Resolution Temperature (SB38):	
Range	-5 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
Integrated Sensor Module (ISM)	
Heading Accuracy (after Field)	1°

## Calibration):

Heading Precision:	0.25°
Heading Resolution:	0.1°
Maximum tilt:	±70°
Pitch Range:	±90°
Roll Range:	±180°
Pitch/Roll Accuracy:	±0.3°
Pitch/Roll Precision:	0.1°
Pitch/Roll Resolution:	0.06°

**Pressure Sensor, 750m (Keller PA-7L, 100 Bar)**

Range	0 to 10,000 kPa
Accuracy	%FS 0.25 typ, 0.5 max
Pressure Resolution	1 Deci-pascal (.01 kPa) for PDO, 1 Pascal for PD20
Depth Output Range	0 to 750 meters
Depth Resolution	.01 meter

**Pressure Sensor, 6000m (Keller PA-7LHP, 600 Bar)**

Range	0 to 60,000 kPa
Accuracy	%FS 0.25 typ, 0.5 max
Pressure Resolution	1 Deci-pascal (.01 kPa) for PDO, 1 Pascal for PD20
Depth Output Range	0 to 6000 meters
Depth Resolution	.01 meter

# Outline Installation Drawings

The following drawings show the standard DVS dimensions and weights.



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.



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

**Table 13. Outline Installation Drawings**

Drawing #	Description
96B-6036	DVSII IMM/EXT Cable, RS232
96B-6037	DVSII SEB38, IMM/EXT Cable
96B-6038	DVSII EXT Cable, 6000M
96B-6039	DVSII IMM/EXT Cable, CTD, 6000M
96B-6040	DVSII IMM/EXT Cable, RS232, 6000M
96B-6041	DVSII SEB38, EXT Cable
96B-6042	DVSII EXT Cable Only, 750M
96B-6052	DVSII EXT Cable, Pressure Sensor, 750M
96B-6053	DVSII IMM/EXT Cable, Pressure Sensor, 6000M
96B-6054	DVSII EXT Cable, Pressure Sensor, 6000M
96B-6055	DVSII IMM/EXT Cable, Pressure Sensor, 750M

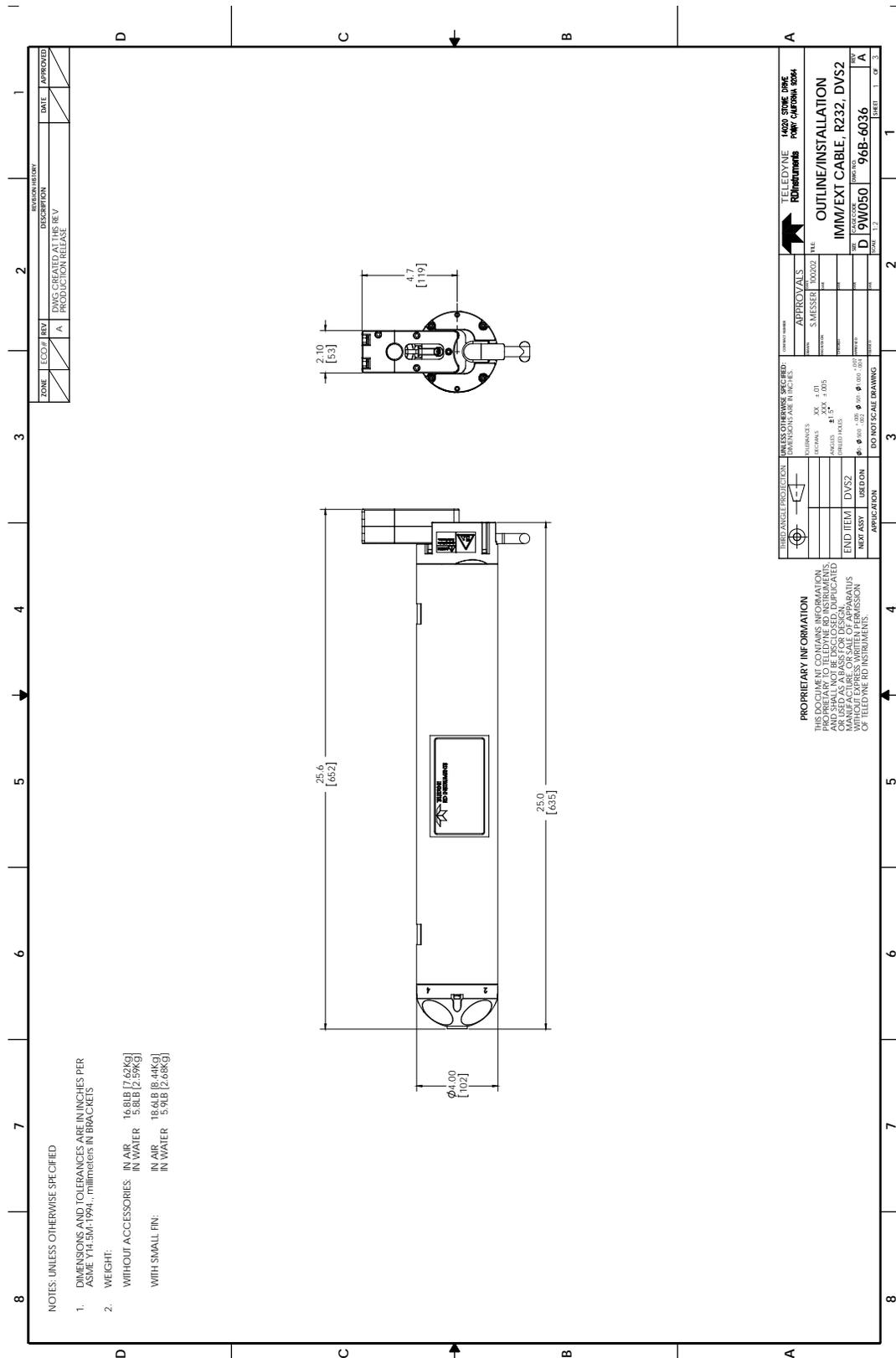


Figure 50. Outline Installation Drawing 96B-6036 Sheet 1

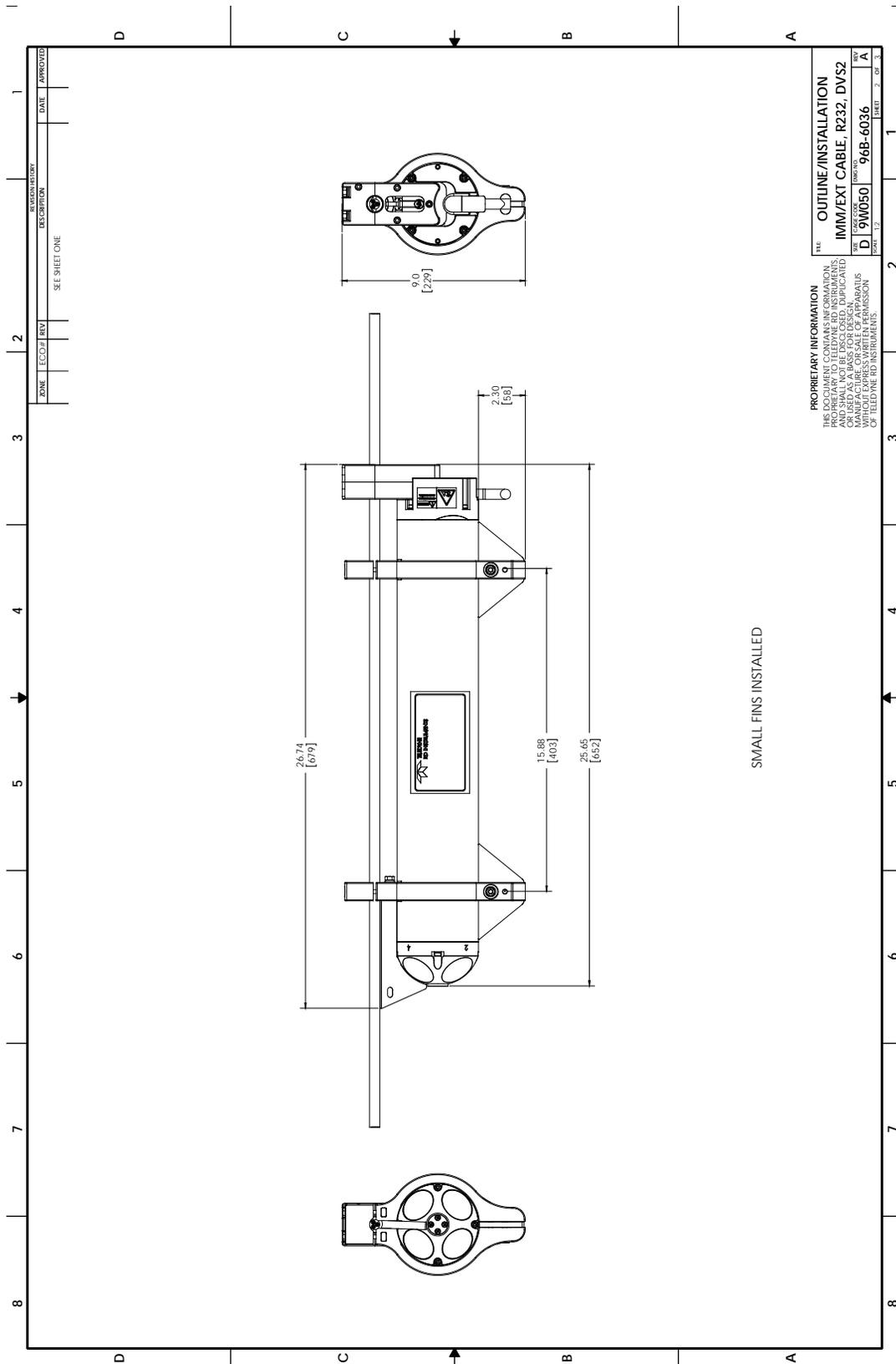


Figure 51. Outline Installation Drawing 96B-6036 Sheet 2

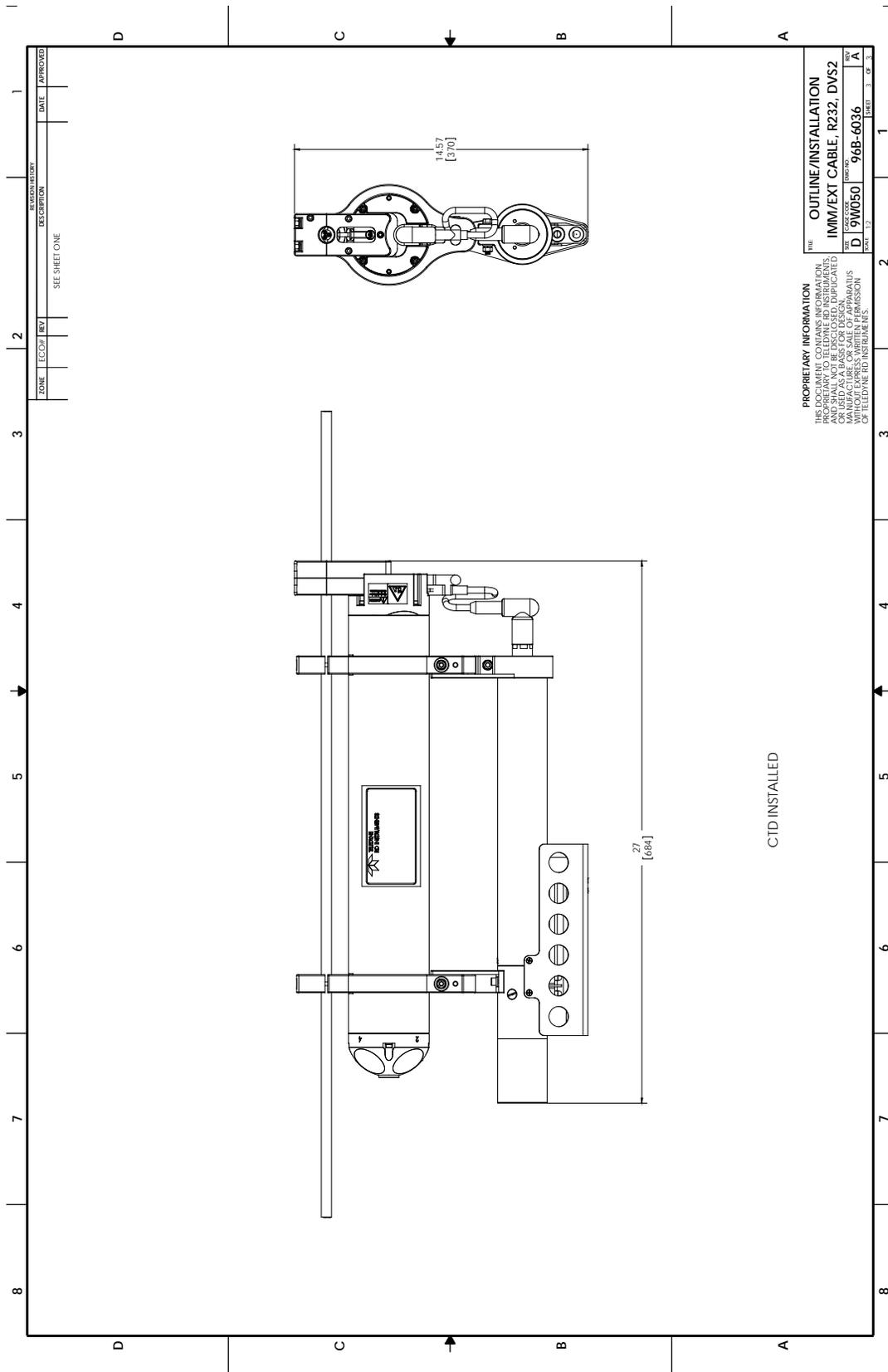


Figure 52. Outline Installation Drawing 96B-6036 Sheet 3

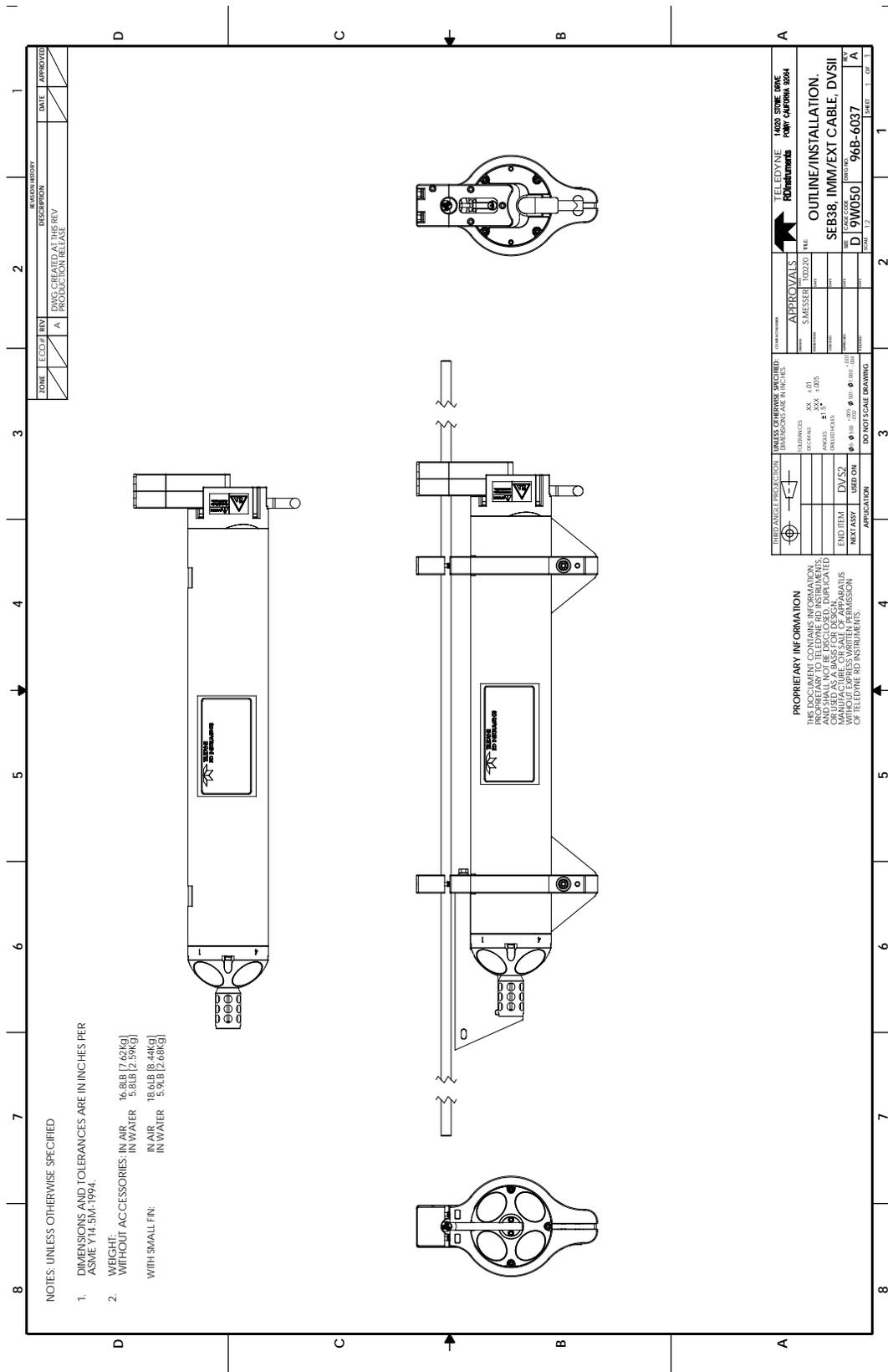


Figure 53. Outline Installation Drawing 96B-6037

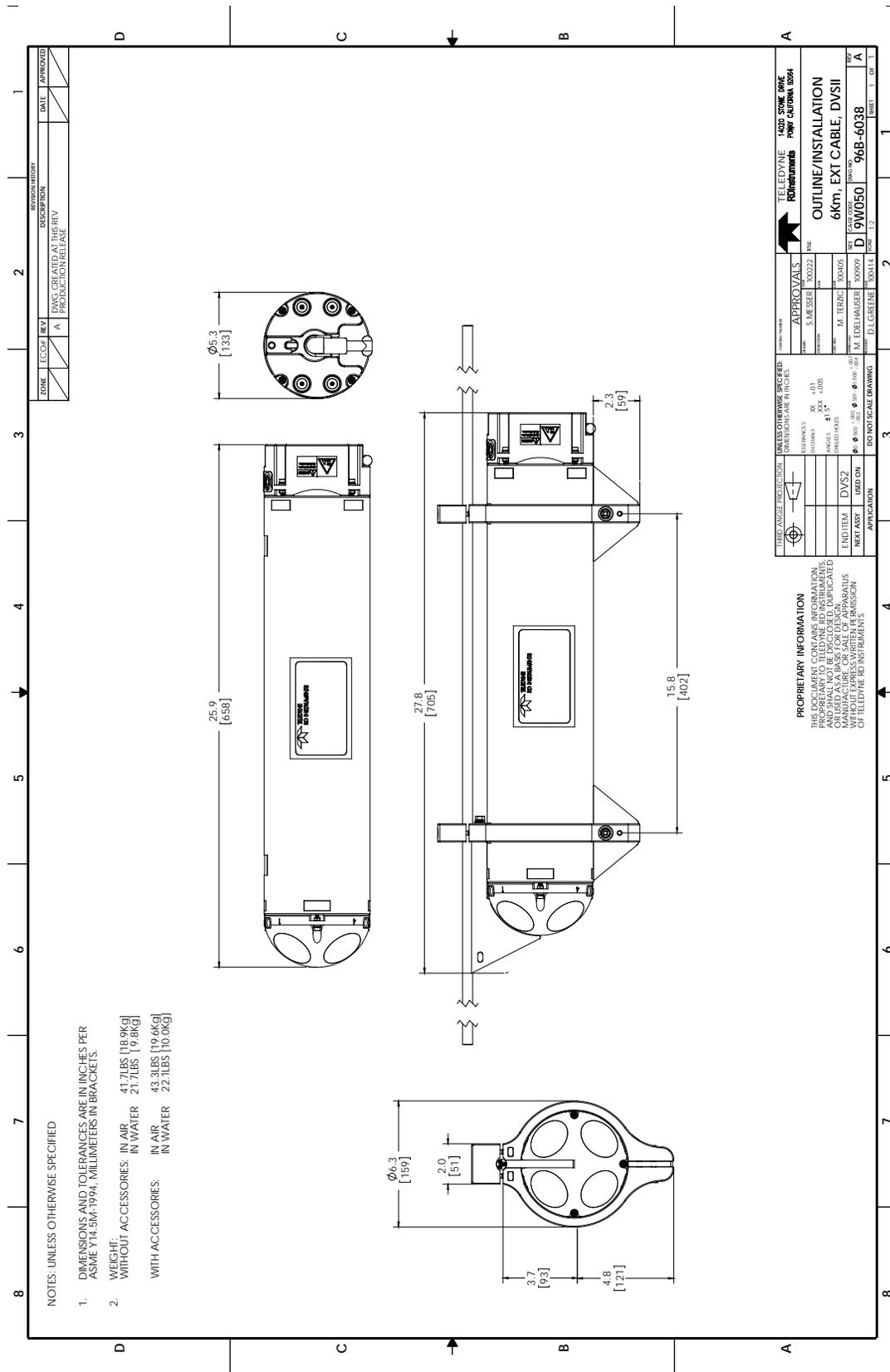
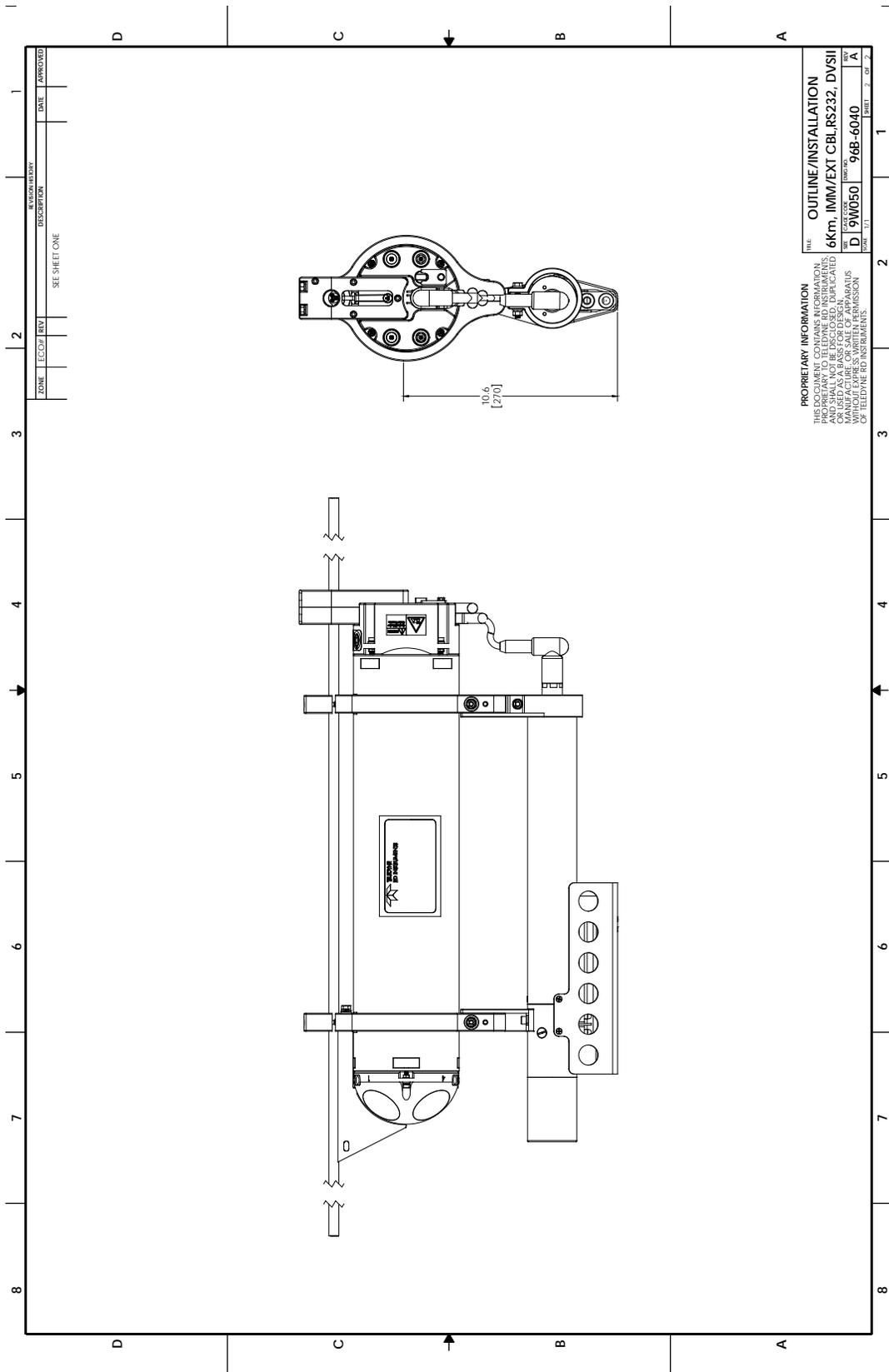


Figure 54. Outline Installation Drawing 96B-6038







TITLE: **OUTLINE/INSTALLATION**  
 MODEL: **6km, IMM/EXT CBL, RS232, DVSII**  
 PART NO.: **D 9W050** (REV. 00)  
 DATE: **96B-6040**  
 SHEET: **2** OF **2**

**PROPRIETARY INFORMATION**  
 THIS DOCUMENT CONTAINS INFORMATION  
 WHICH IS THE PROPERTY OF TELEDYNE RD  
 INSTRUMENTS AND SHALL NOT BE REPRODUCED,  
 COPIED, OR USED AS A BASIS FOR DESIGN,  
 OR IN ANY MANNER, WITHOUT THE WRITTEN  
 PERMISSION OF TELEDYNE RD INSTRUMENTS.

Figure 57. Outline Installation Drawing 96B-6040 Sheet 2



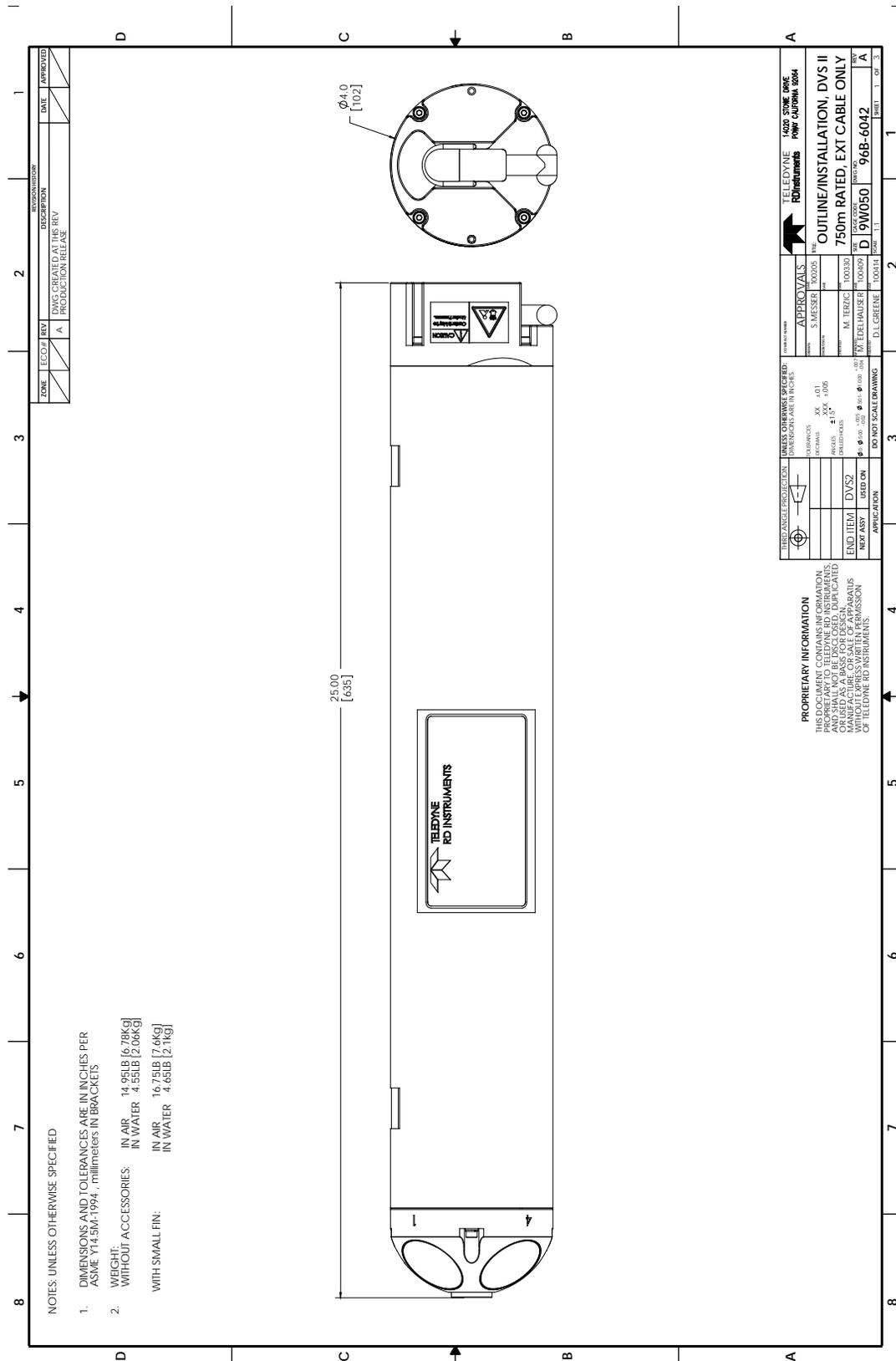
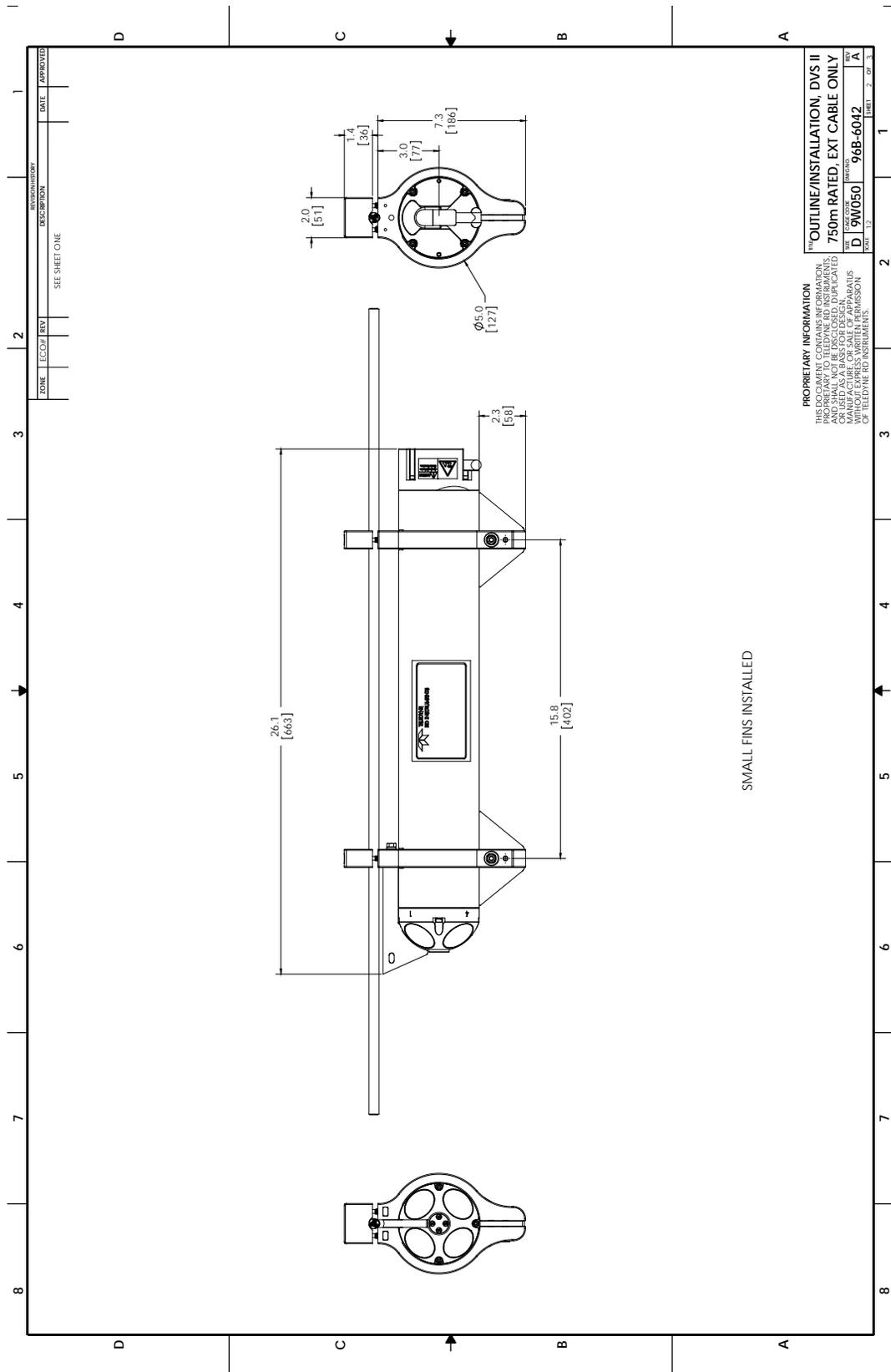


Figure 59. Outline Installation Drawing 96B-6042 Sheet 1



**PROPRIETARY INFORMATION**  
 THIS DOCUMENT CONTAINS INFORMATION  
 WHICH IS THE PROPERTY OF TELEDYNE  
 AND SHALL NOT BE REPRODUCED, COPIED,  
 OR USED AS A BASIS FOR DESIGN,  
 WITHOUT EXPRESS WRITTEN PERMISSION  
 OF TELEDYNE RD INSTRUMENTS.

**OUTLINE/INSTALLATION, DVS II**  
**750m RATED, EXT CABLE ONLY**

REV: 1.2  
 DATE: 09/05/10  
 DRAWING NO: 96B-6042  
 SHEET 2 OF 3

Figure 60. Outline Installation Drawing 96B-6042 Sheet 2

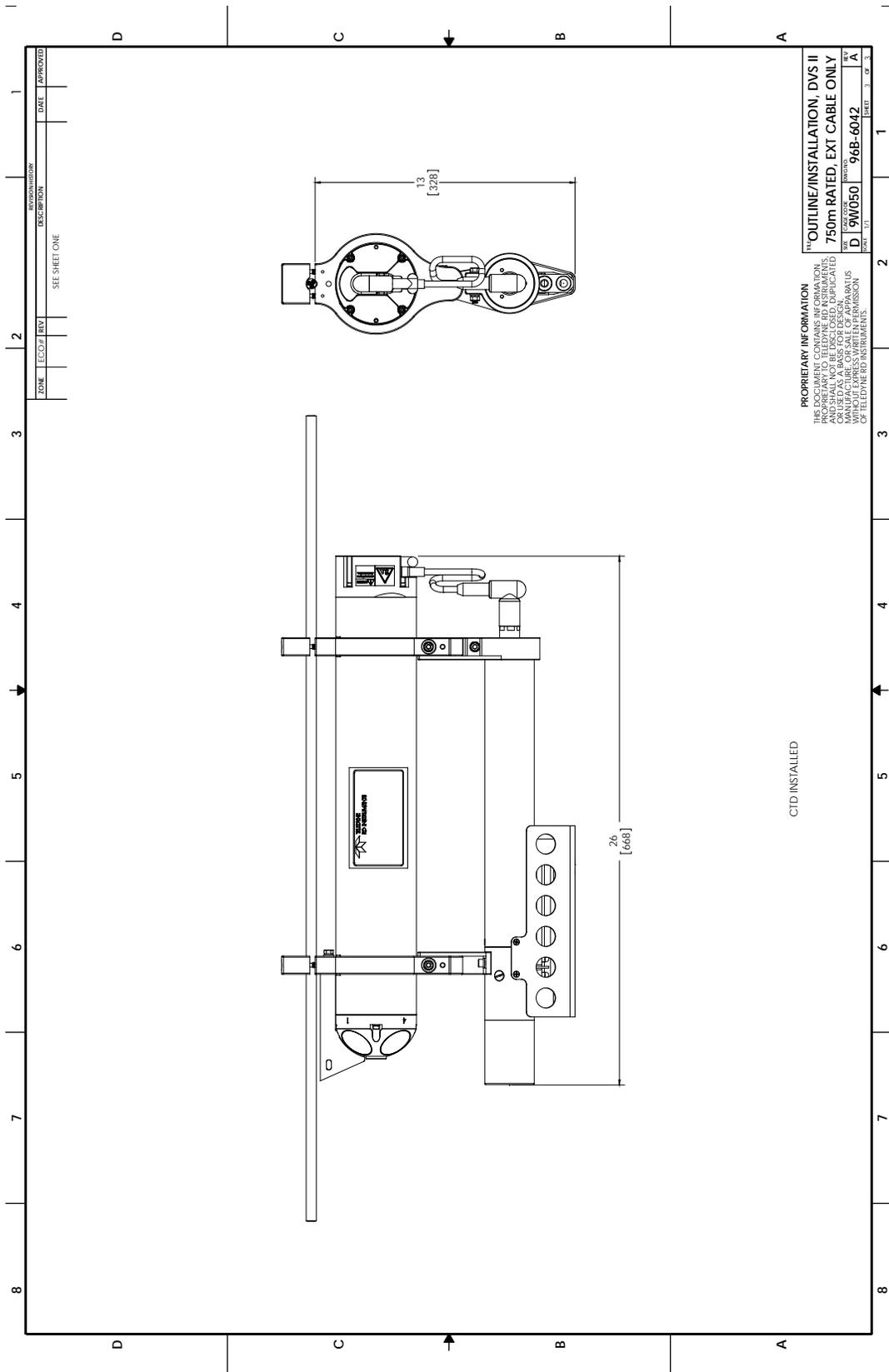


Figure 61. Outline Installation Drawing 96B-6042 Sheet 3



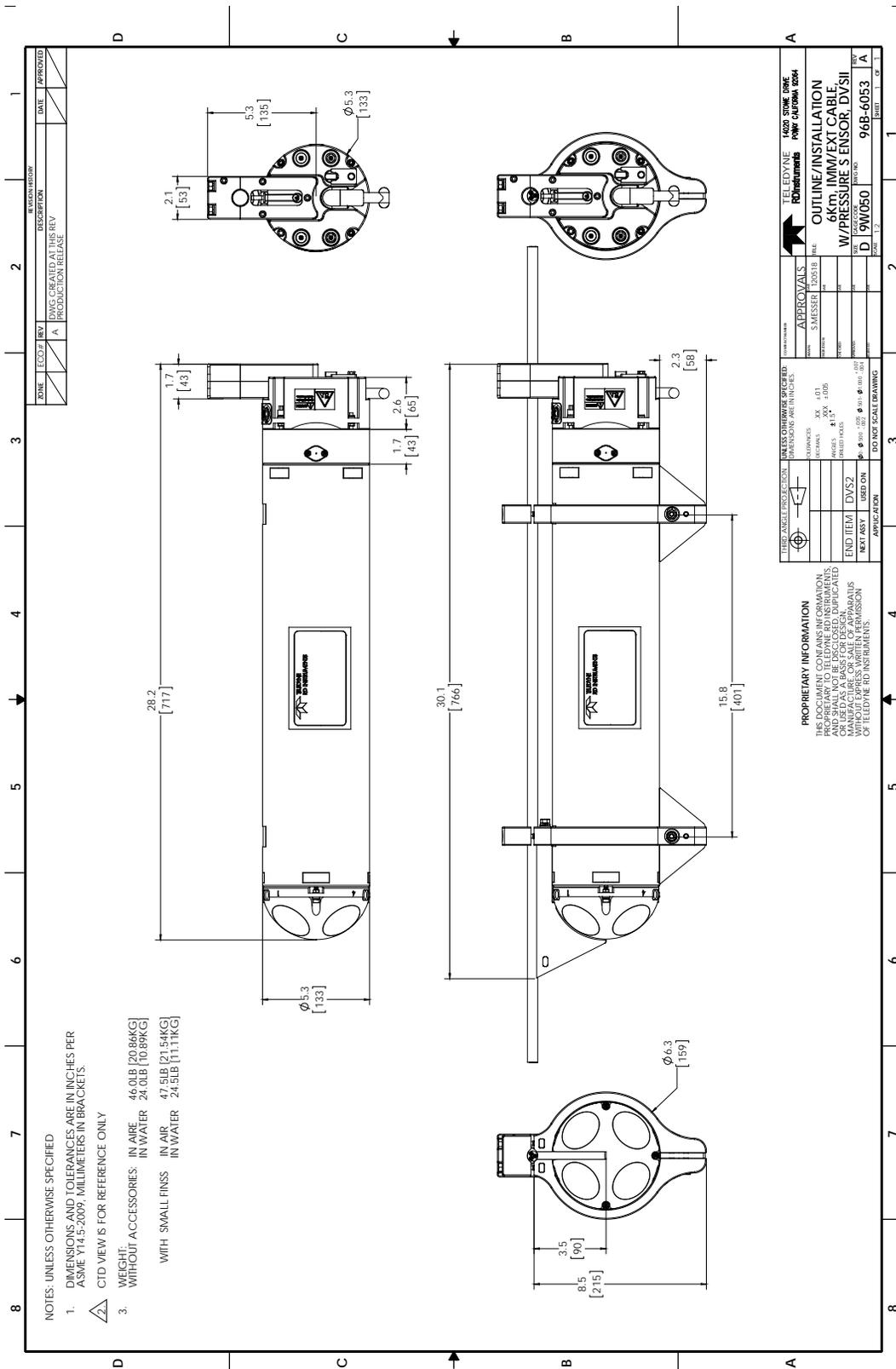


Figure 63. Outline Installation Drawing 96B-6053





# Chapter 8

## USING COMMANDS



In this chapter, you will learn:

- How to enter commands
- Data output processing
- Firmware updates
- Command descriptions

This guide defines the commands used by the DVS. These commands (Table 15) 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 16). 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 15 directly affect the range of the DVS, the standard deviation (precision) of the data, and battery usage.



This guide applies to DVS firmware version 55.xx.

DVS firmware versions 55.xx are NOT backwards compatible with DVS 41.xx firmware.

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.rdinstruments.com](http://www.rdinstruments.com).

## 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 or RS-422 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.

```
>
DVS
Teledyne RD Instruments (c) 2010
All rights reserved.
Firmware Version: 55.xx
>
```

## 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 redisplay the ">" prompt. Some examples of commands that produce output data are ? (help menus), CS (start ping), 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.

## Data Output Processing

The DVS allows several modes of operation for flexibility. In polled operation, the DVS will take one or more ensembles on command, and transmit the data, including a time stamp, via the inductive modem. In Autonomous operation, the DVS can be set to collect 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 an “ensemble” as a group of pings that are averaged over a period of time. The user can specify the number of pings to collect and average together into an ensemble for output, and can also specify the time between pings within an ensemble, as well as the time between ensembles. By setting the time between pings, the user can choose whether an ensemble will consist of pings taken consecutively in a burst, or spread out over the time of the ensemble interval.

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 CRO 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).

# Firmware Updates

The firmware for DVS units is located on flash RAM chips on the DSP board. When new firmware versions are released, they are posted to TRDI's website. Use the following procedure to install the firmware update in the DVS.

1. Connect your DVS to the computer as shown in [Testing the DVS](#).
2. Start the program *DVSII\_FW.exe*.



Be sure to download the correct version of firmware. DVS firmware versions 55.xx are NOT backwards compatible with DVS 41.xx firmware.

3. Click **Setup**. Click the **View README.TXT** button to view the Readme.txt file for details on what is new in this version of the firmware.
4. Click **Next** and follow the on-screen prompts.
5. If you are not able to install the new firmware, contact Customer Service (see [How to Contact Teledyne RD Instrument](#)).
6. After successfully upgrading the firmware, Use the DVS software to test the DVS (see [Testing the DVS](#)).



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.

## Using Direct Commands to Deploy the 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 14 be the ***minimum*** commands you send to the instrument.



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 14: DVS Minimum Required Commands for Deployments**

Command	Description
CR1	This command will set your DVS to a known factory default setting and <b>must be your first command</b>
CFxxxx	This command will set your DVS collection mode; binary, etc.
ESxx	This command will set the salinity of the water
EAXxxx	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
EXxxxx	This command will set your DVS's coordinate system; earth, beam, etc.

Command	Description
CR1	This command will set your DVS to a known factory default setting and <b>must be your first command</b>
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 pings to average
WSxxxx	This command will set the depth cell size to use
TExxxxxxx	This command will set the time between ensembles
TPxxxxxx	This command will set the time between pings
CK	This command will save your setup to the internal RAM and <b>must be your second to last command</b>
CS	This command will start your deployment and <b>must be your last command</b>



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



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 ping every 10 minutes.

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

# Command Summary

Table 15 gives a summary of the DVS input commands, their format, and a brief description of the parameters they control. Table 16 lists the factory default command settings.



Certain performance and testing commands are not designed to be utilized while communicating via the inductive modem. These include PT commands, PC3, and PC30.



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 15: DVS Input Command Summary**

Command	Description
?	Shows command menu (deploy or system)
<End>	Break - Interrupts or wakes up DVS and loads last settings used
+++ or ===	Soft Break
Y	Display banner
CA	Communication Timeout
CBnnn	Serial port control (baud rate/parity/stop bits)
CFnnnn	Flow control
CK	Keep parameters as user defaults
CL	Sleep Enable
CO	Collect and Output A Sample
CRn	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)
ECnnnn	Speed of Sound (1400 to 1600 m/s)
EDnnnn	Transducer Depth (0 to 65535 dm)
EHnnnn	Heading (000.00 to 359.99 degrees)
EP±nnnn	Pitch (-60.00 to +60.00 degrees)
ER±nnnn	Roll (-60.00 to +60.00 degrees)
ESnn	Salinity (0 to 40)
ET±nnnn	Water Temperature (-5.00 to +45.00 degrees C)
EXnnnn	Coordinate Transformation (Xform:Type; Tilts; 3Bm; Map)
EZnnnnnn	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
PC20	Display Scrolling Sensor Data
PC3	Display CTD Sensor Data
PC30	Display Scrolling CTD Sensor Data
PC4	Display Voltage Monitor ADC Data
PC40	Display Scrolling Voltage Monitor Data
PD	Data Stream Select
PF	Results from most recent PA tests

**Table 15: DVS Input Command Summary**

Command	Description
PS0	Display System Configuration
PS3	Display Instrument Transformation Matrix
PT3	Built-In test
SA	Compass Commands
SB	Temperature Commands
SE	CTD Commands
SZ	Sensors [Compass(ReadOnly), Temp(ReadOnly), CTD(0,1)]
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 Pings
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;*;*;*}
WFnnnn	Blanking Distance (0 to 9999 cm)
WNn	Number of Bins [1-5]
WPnnn	Number of Pings
WSnnnn	Bin Size

**Table 16: 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

# 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).

## Miscellaneous Commands

### Break

**Purpose** Wakes up the DVS so it can accept commands.



Recommended Setting. Use as needed.

**Description** If the Break is issued over the RS-232 or RS-422 port, the DVS is reset and any deployment in progress is stopped.

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.

Using *BBTalk*, pressing the **End** key sends a BREAK.



Any character received through the RS-232 or RS-422 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** +++ or ===

**Description** Resets the DVS, and stops any deployment in progress. Sending a soft break sets the command port to the serial port.



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.

```
>y
DVS
Teledyne RD Instruments (c) 2008
All rights reserved.
Firmware Version: 41.16
Library Version Info:
  Kernel:      KERNEL_V0.19
  Framework:   FRAMEWORK_V0.20
  Common:      COMMON_V0.33
```

## OI – Install Feature

**Purpose** This command installs or uninstalls the CTD feature. Send a BREAK and then the CR1 and CK commands after entering the code.

**Format** OI

```
>OI
-----1-----2-----
Enter Code: ABBxxxxxxxxxxxxxxxxxxxxxxxx76

Code entered: ABBxxxxxxxxxxxxxxxxxxxxxxxx76
Features installed. Send <BREAK> to activate.

>
```



In order to communicate properly, the CTD must be in the following state:

- The baud rate of the CTD should be set up to match that of the DVS.
- Any CTD polling must be “stopped” so that it is awaiting commands.
- The “executed command” output option should be disabled.

## OL – Display Feature List

**Purpose** This command displays installed feature(s).

**Format** OL

```
>OL
FEATURES
-----
Feature                               Installed
-----
CTD                                    No
```

See your technical manual or contact TRDI for information on how to install additional capability in your DVS.

>

# Control System Commands

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

## Available Control System Commands

This section lists the Control System commands.

```
>c?
Available Commands:

CA  120 ----- Communication Timeout (0=Off,10-65536 sec)
CB  711 ----- Serial Port Control {baud;parity;stop}
CF 11100 ----- 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
CSTATE ----- Pinging State Query
CSTOP ----- Stop Pinging
CT  0 ----- Turnkey (0 = OFF, 1 = ON)
CV ----- Output Average Ensemble
CW ----- Output the Last Stored Ensemble
CZ ----- Put the DVS to sleep.
C? ----- Display C-Command Menu
```

## Control System Command Descriptions

### CA – Communication Timeout

Purpose	Sets the timeout period for the activity timer.
Format	CA <code>nnnnn</code>
Range	<code>nnnnn</code> = 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 17: 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.

1. Connect and power up the DVS unit as shown in [Set Up the DVS](#).
2. Start the *DVS* program and begin a terminal session with the DVS (see [Using the DVS Software Terminal Screen](#)).
3. Send the command CR1 to place the DVS in the factory default setup.
4. 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 18: Baud Rate**

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

5. Send the command CK to save the new baud rate setting.
6. 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.



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	CFnnnnn
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 19: 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 – <b>Manual ensemble not currently available.</b>
CFx1xxx	Automatic Ping Cycling – Pings immediately when ready.
CFx0xxx	Manual Ping Cycling – <b>Manual ping cycling not currently available.</b>
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 or RS-422 serial interface.
CFxxx0x	Disable Serial Output – No ensemble data are sent out the RS-232 or RS-422 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 CRO-command.

## CL – Sleep Enable

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



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 Ping

**Purpose** Tells the DVS to collect a ping and transmit the data in PD20 or PD0 format.



Pings collected with the CO command 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 ping. Each ping contains a time stamp. An error message will be given if this command is issued too close to the next scheduled ping time.



The CO command does not work when communicating through the IMM. The IMM times out before the CTD collects a sample. The THOST2 setting needs to be increased to 5 seconds in order for IMM to wait long enough for CTD (see [DVS IMM Timeouts](#)).

**Once the CO command is sent, set THOST2 back to 2 seconds. If THOST2 is left at 5 seconds, the DVS battery will drain much faster than normal.**



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 20: 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).



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.



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 the period set by the CA command.

## CV – Output Average Ensemble

**Purpose** Requests the average of all ensembles 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 ensembles 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.



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 PDO or PD20 output formats, and follows the CF command setting for binary or Hex-ASCII output.



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.



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 (default CA command) if no command is sent.



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.*

# Environmental Commands

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

## 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;i;p;r;s;t}
E? ----- Display E-Command Menu
```

## 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.

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



The EB command only affects calculated velocities, not the compass heading output.

## EC - Speed of Sound

<b>Purpose</b>	Sets the speed of sound value used for DVS data processing.
<b>Format</b>	ECnnnn
<b>Range</b>	nnnn = 1400 to 1600 meters per second
<b>Default</b>	EC1500



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

<b>Description</b>	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.
--------------------	--



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

<b>Purpose</b>	Sets the DVS transducer depth.
<b>Format</b>	EDnnnnn
<b>Range</b>	nnnnn = 0 to 65535 deci-meters (meters x 10)
<b>Default</b>	ED00000



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

<b>Description</b>	ED sets the DVS transducer depth. This measurement is taken from sea level to the pressure sensor. 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 pressure sensor. See the primer for information on speed of sound calculations.
--------------------	--



The ED command is not used if the EZ command is set to calculate speed of sound based on temperature, salinity, and transducer depth. If the EZ transducer depth field is set to 1, the DVS overrides the manually set ED value and uses depth from the internal pressure sensor. If a pressure sensor is not installed, the DVS uses the manual ED setting.

## EH - Heading

Purpose	Sets the DVS heading angle.
Format	EHnnnnnn
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.



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



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



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 $\pm nnnn$
Range	$\pm nnnn = -500$ 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



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 $b =$ not used
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 21: 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	Not used



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.

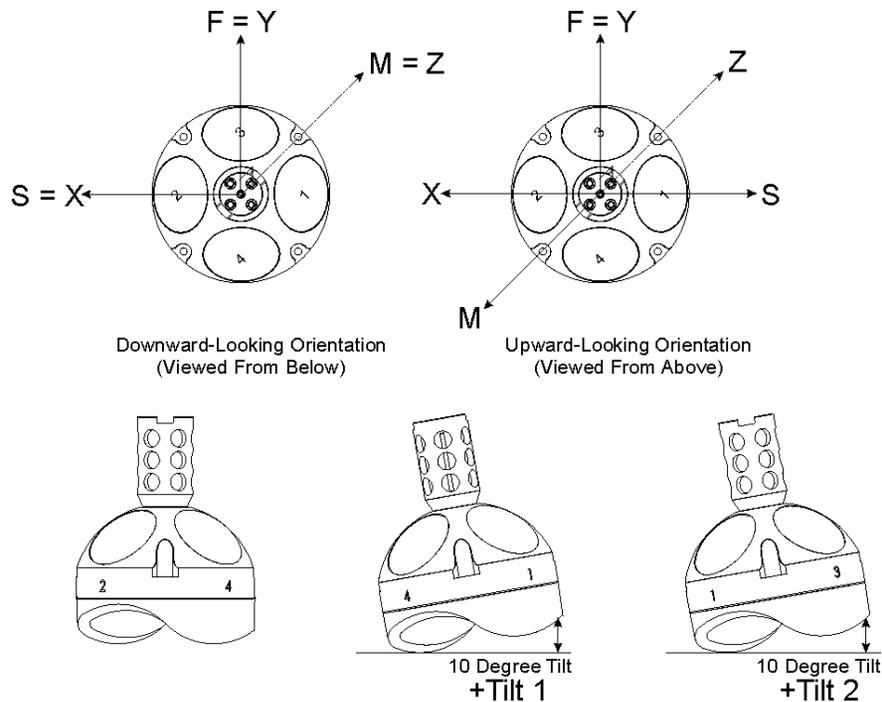


Figure 66. DVS Coordinate Transformation

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** EZcdhprst  
**Default** EZ1011101



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 22: Sensor Source Switch Settings**

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

**Example**      EZ1011101 means calculate speed of sound from readings, use heading, pitch, roll sensors, and the temperature sensor.

```
>EZ?
EZ 1011101 ----- Sensor Source {c;d;h;p;r;s;t}
>
```

# 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.

## 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
```

## 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...]
```



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 <i>xxx</i>
Range	<i>xxx</i> = 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 <i>DVS</i> (see the <i>DVS Software User’s Guide</i> for instructions).
-------------	---

## MQ – Streaming Download

Purpose	Downloads the recorder.
Format	MQ (StartAddr, nbytes)
Range	StartAddr: 0 to FFFFFFFE (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.
-------------	---



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 <i>n</i>
Range	<i>n</i> = 0, turn recorder off; <i>n</i> = 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.

The MY command 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.



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.

# Performance and Testing Commands

The DVS uses the following commands for calibration and testing.

## 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
```

## 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.



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, 3, 4, 20, 30, 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.

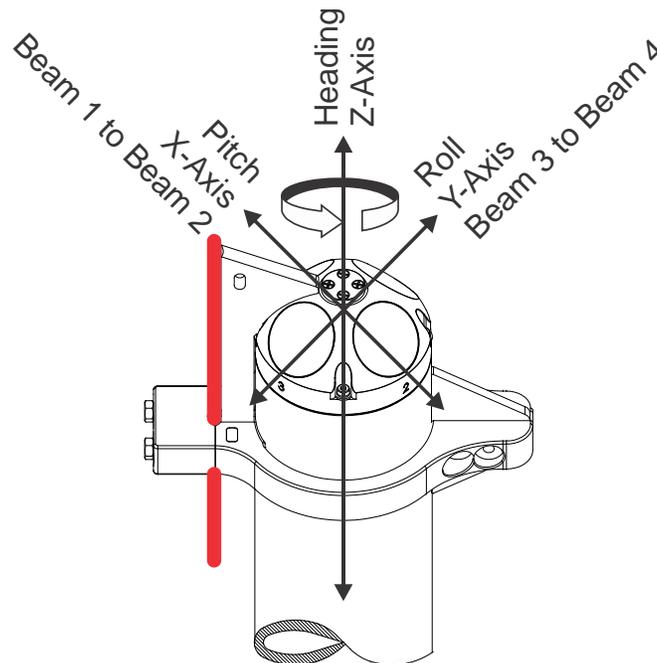


Figure 67. Pitch, Roll, and Heading

- **Heading** - When Beam 3 is pointed toward true north, heading = 0°.
- **Pitch (Tilt 1)** - When the unit is pointed up or down, pitch = 0°. When the unit is on its side, pitch = ±90°.
- **Roll (Tilt 2)** - When the unit is pointed down, roll = 0°. When the unit is pointed up, roll = ±180°.



The PC2 and PC20 commands will display the raw pitch and roll as received by the

internal sensor (either TCM5 or ISM depending on the year and model of the DVS). When the DVS collects a ping, it will limit the pitch and roll to the  $-70.00^\circ$  to  $+70.00^\circ$  range.

In the PD20 data, the transducer orientation can be determined by decoding the BIN 1 DISTANCE bytes 54 and 55 in the Scalar Data Format as a signed number (see [Data Decoding Sequence for Data Format PD20](#)).

PC2 and PC20 Raw (unprocessed) Pitch (Tilt1) and Roll (Tilt2) will behave as follow:

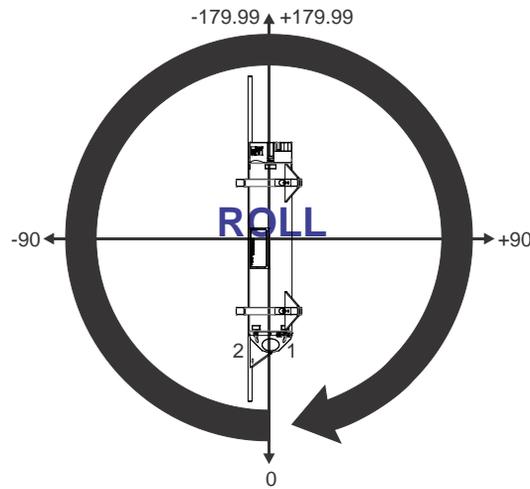


Figure 68. PC2 and PC20 Raw Roll

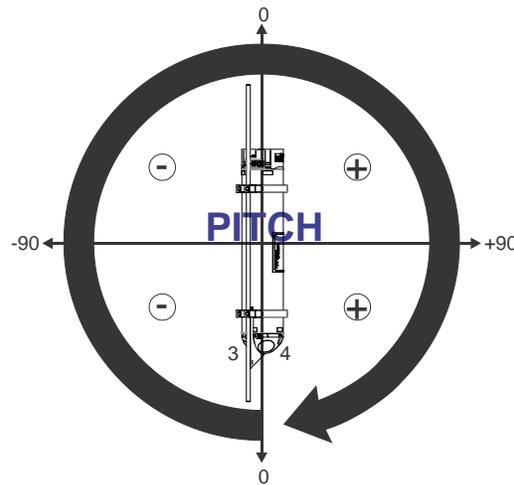


Figure 69. PC2 and PC20 Raw Pitch

The following table describes the sign convention for the Pitch and Roll stored in the PD20/PDO binary output data.

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

## PC3 - Display CTD Sensor Data

This command samples CTD continuously and displays data without scrolling.

```
>pc3
CTD data is sampled and displayed in a loop.
Press any key to exit the loop.
```

Count	Temp (c)	Pressure (dbar)	Salinity (psu)
/ 4	23.7852	-0.335	0.0114

## 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

## PC30 - Display Scrolling CTD Data

This command samples CTD continuously and displays data with scrolling.

```
>pc30
CTD data is sampled and displayed in a loop.
Press any key to exit the loop.
```

Count	Temp (c)	Pressure (dbar)	Salinity (psu)
1	23.7885	-0.335	0.0114
2	23.7891	-0.335	0.0114
3	23.7878	-0.335	0.0114

## 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 serial 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, 22

**Default** PD22



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 23: Data Stream Selections**

Format	Description
PD0	Output TRDI standard binary data
PD20	Output DVS format data
PD22	The default Output Data Format for the DVS is PD22. This command will output ensemble #1 in both PD0 and PD20 formats to the recorder, but only PD20 format to the real-time serial output. All other ensembles are output in PD20 format.

## 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.

```

>PF
  Test Results
PA Test last run at: 2009/04/02 20:56:13.53

RAM      test... PASSED
ROM      test... PASSED
RTC      test... PASSED
REC      test... FAILED
UART     test... PASSED
COMPASS  test... PASSED
TEMPERATURE test... PASSED
CTD      test... PASSED
NO-GO

>

```

## 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: 8922
    Frequency: 2457600 Hz
  Transducer Type: PISTON
    Beam Angle: 45 Degrees
    Beam Pattern: CONVEX
    Sensors:
      Temperature:      Integrated Sensor Module (ISM)
      Heading/Pitch/Roll: Integrated Sensor Module (ISM)
      CTD:              SeaBird SBE 37-SMP

    CPU Firmware: 41.16b
    FPGA Version: 5.00.003 [0x5003]

Board Serial Number Data:
3E 00 00 00 3D 88 20 23  PIO72B-2231-14A
6F 00 00 00 3D 39 D8 23  DSP72B-2232-00A
14 00 00 00 33 71 04 23  XDR72B-1001-14A
82 00 00 00 3C F7 14 23  RCV72B-2233-14A
9A 00 00 00 7A CF 9C 23  PER72B-2250-00X

```

>

### 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](http://www.rdinstruments.com)).

## PT - Built-In Tests

**Purpose** Sends/displays results of DVS system diagnostic test.

**Format** *PTnn*

**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  = Help
PT3  = Receive Path Test
PT11 = FRAM Test
PT12 = RAM Test
PT13 = ROM Test
PT14 = Recorder Test
PT15 = Communications Test
PT16 = Clock Test
PT17 = Compass Test
PT18 = Temperature Test
PT19 = CTD Test
>

```

### 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  88  87  88  89      79  80  78  79    76  78  76  74    74  72  74  74
2  66  59  62  67      44  44  46  45    38  41  39  34    37  32  40  33
3  43  35  39  47      22  19  19  21     9  18  12  14    12  9  14  8
4  26  21  25  34      11  8  8  11     4  9  4  13     4  5  3  9
5  13  8  14  25       9  7  2  10     5  7  7  12     5  7  2  11
6  5  1  9  18        10  4  1  9      1  5  8  4      7  6  5  8
7  4  3  5  13        9  5  6  4      2  2  6  4      6  3  9  3

Sin Duty Cycle (percent)
55 53 53 49   51 49 47 47   48 56 49 49   54 53 50 48
Cos Duty Cycle (percent)
54 48 48 53   50 46 50 51   48 54 56 56   51 52 51 48
RSSI Noise Floor (counts)
61 68 68 56   55 61 61 50   67 74 74 63   56 61 61 50

>
```



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):

- **Pattern Test:** Writes 4 patterns to each address in the FRAM space, and reads back from these addresses to make sure the data was correctly written.
- **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.
- **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 consecutive 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 MEM0:

Blank check MEM1:

Rec Flash Pattern Test:
Testing 10 addresses in sector #78

Rec Flash Pattern Test:
Testing 10 addresses in sector #111

Recorder Flash Test: PASS
```



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.



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
```

&gt;

**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 ]
```

&gt;

**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 ]
```

&gt;

**PT19 – CTD Sensor**

This command samples the CTD and displays data.

```
>pt19
CTD test.....PASS [ 23.857199, -0.333000, 0.011500 ]
```

## Sensor Commands

The DVS uses the following commands for calibrating the sensors.

### Available Sensor Commands

```
>s?
Available Commands:
SA 2 ----- Compass Commands
SB 2 ----- Temperature Commands
SC ----- Compass Calibration [0=new,1=factory,2=save]
SG 50 1 ----- Configure Compass Cal (nPts[1-50] StabChk[1,0])
SP ----- Pressure Sensor Commands (sp0=menu)
SZ 2201 ----- Sensors [Compass(R), Temp(R), CTD(0,1), Press(R)]
S? ----- Display S-Command Menu
>
```

## Sensor Commands Descriptions

### SA – Compass Commands

Purpose	Displays information about the compass.
Format	SA <i>n</i>
Range	<i>n</i> = ?, 0, 1, 2
Default	N/A



Recommended Setting. Use as needed.

**Description**      Displays the command information and the compass configured for the system.

**Example**            See below

### SA?

Sending SA? will display the compass type where,

0 = None,

1 = TCM5,

2 = Integrated Sensor Module (ISM).

```
>SA?
SA 2 ----- Compass Commands
>
```

### SA0

Display available commands for the configured compass sensor.

```
>SA0

ISM Commands:
SA0 ----- Display ISM Commands
SA1 ----- Pass Through Mode
SA2 ----- ISM Module Info

>
```

### SA1

Put compass into Pass Through mode. Send a BREAK to exit the Pass Through mode.

### SA2

Display the ISM compass module information.

```
>sa2
Part No. : SNR71B-1048-52
Serial No. : 23C41B52 00000038
FW Version : 45.03

>
```

## SB – Temperature Commands

**Purpose**            Displays information about the temperature sensor.

**Format**            SB*n*

**Range**            *n* = ?, 0, 1

**Default**          N/A



Recommended Setting. Use as needed.

**Description**      Display command information and the temperature sensor configured for the system.

**Example**            See below

### SB?

Sending SB? will display the sensor type where,

0 = None

1 = TRDI SENSOR (1-wire)

2 = SEA-BIRD SENSOR (SBE38)

3 = Integrated Sensor Module (ISM)

```
>SB?
SB 2 ----- Temperature Commands
>
```

### SB0

Display the available commands for the configured temperature sensor (SBE38 in this case).

```
>SB0

SBE38 Commands:
SB0 ----- Display SBE38 Commands
SB1 ----- Pass Through Mode

>
```

### SB1

Put the SBE38 in Pass Through mode. Press the RETURN key to see the SBE38 prompt. Send a BREAK to exit the Pass Through mode.

```
>SB1
S>
```

## SC – Compass Calibration

**Purpose** Calibrates or resets the ISM compass.

**Format** SC $x$

**Range**  $x = 0$  (Perform field calibration),  
 $x = 1$  (Restore factory calibration)  
 $x = 2$  (Save)

**Default** N/A



Recommended Setting. Use the DVS software to calibrate the compass.

**Description** The DVS software uses the SC command to calibrate the compass or reset the compass to the factory calibration.

## SE – CTD Commands

**Purpose** Displays information about the CTD.

**Format** SE $n$

**Range**  $n = 1$ : enabled, 0: disabled

**Default** N/A



Recommended Setting. Use as needed.

**Description** Display command information and shows if the CTD is enabled. The SE commands are not available if CTD feature is not installed or CTD is disabled by the user.

**Example** See below

```
>SE?
SE 1 ----- CTD Commands
>
```

## SE0

Display available commands for the configured CTD sensor.

```
>SE0

SBE 37-SMP Commands:
  SE0 ----- Display SBE37SMP Commands
  SE1 ----- Pass Through Mode
>
```

## SE1

Put CTD to Pass Through mode. Send a BREAK to exit the Pass Through mode.

```
>SE?
SE 1 ----- CTD Commands
>
```

## 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. Use the DVS software to calibrate the compass.

**Description** *nPts* is the number of samples that the ISM compass will take during a field calibration. *StabChk* is a flag that indicates whether or not the ISM 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 ISM 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.

## SP – Pressure Sensor Commands

**Purpose** Displays information about the Pressure Sensor.

**Format** SP*n*

**Range** *n* = 1: enabled, 0: disabled

**Default** N/A



Recommended Setting. Use as needed.

**Description**      Display command information and shows if the pressure sensor is enabled. The SP commands are not available if pressure sensor is not installed or if pressure sensor is disabled by the user.

**Example**            See below

```
>sp?
SP ----- Pressure Sensor Commands (sp0=menu)
>
```

### SP0

Display available commands for the pressure sensor.

```
>sp0

Pressure Sensor Commands:
SP0 ----- Display Pressure Sensor Commands
SP2 ----- Pressure Device Info
SP3 ----- Zero Pressure Sensor
SP4 ----- Get Pressure Measurement
SP5 ----- Get Temperature Measurement

Pressure Sensor = Keller30            // if the sensor is enabled, OR
Pressure Sensor = Manual            // if the sensor is disabled
>
```

### SP2

Displays the pressure sensor device information.

```
>SP2
Class.Group        : 5.20
FW Year / Week    : 2005 / 50
Rx Buf Len        : 10 bytes
Status Info       : 1
Serial Number     : 9675
>
```

### SP3

Zeros the pressure sensor. The zero point will be calculated such that the current measured value will equal 0.

```
>SP3
Pressure sensor successfully zeroed
>
```

### SP4

Takes a pressure sample and displays the result.

```
>sp4
Pressure reading: 753 Pascals
>
```

### SP5

Takes a temperature sample from the pressure sensor and displays the result.



# Timing Commands

The following commands let you set the timing of various DVS profiling functions.

## 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 Pings
TS 06/08/28,19:00:59.61 - Set System Date and Time (yy/mm/dd,hh:mm:ss)
T? ----- Display T-Command Menu
```

## Timing Command Descriptions

### TE – Time Between Ensembles

Purpose	Sets the time between ensembles.
Format	TE <i>hh:mm:ss.ff</i>
Range	<i>hh</i> = hour (00 to 12) <i>mm</i> = minute (00 to 59) <i>ss</i> = second (00 to 59) <i>ff</i> = 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 pings averaged together, where the number of pings per ensemble is set by the WP command.



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 command 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 <u>exact</u> 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 <u>not</u> enter a TF command value.



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 Pings

Purpose	Sets the time between pings.		
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	The TP command sets the time between pings within an ensemble, so if the user wants the pings to be spread evenly throughout the ensemble, the TP command (or the software) must be set accordingly.  During the ensemble interval set by TE, the DVS transmits the number of pings set by the WP-command. TP determines the spacing between the pings. If TP = 0, the DVS pings as quickly as it can based on the time it takes to transmit each ping plus the overhead that occurs for processing. Several commands determine the actual ping time (WF, WN, WS, and actual water depth).
-------------	--

When using the pressure sensor and when the system is sleeping between pings, the DVS needs to power up about 650 milliseconds early on the first ping of each ensemble to give the pressure sensor enough time to power up and be ready to sample. To reduce this extra power overhead on every ping, the pressure sensor is only sampled during the first ping of the ensemble. If the DVS is not sleeping between pings (such as when TP is set too small for sleep, or if CLO command is set to prevent sleep), then the pressure sensor is sampled on each ping and averaged over the ensemble.



If  $TE < TP$ , then TP will dominate. The delimiters are optional, and may be spaces.

Data is output to a file when all pings are finished for that ensemble. CTD data is only output to PD20.

Setting the TP command to less than  $\approx 0.42$  seconds will cause the system to stay awake between pings.

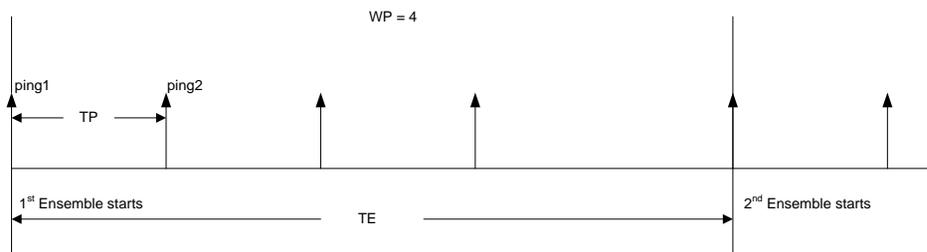


Figure 70. One Ensemble Sample

## TS – Set System Date and Time

**Purpose** Sets the DVS's internal real-time clock.

**Format** TS *yy/mm/dd, hh:mm:ss*

**Range**

<i>yy</i>	= year	00 to 99
<i>mm</i>	= month	01 to 12
<i>dd</i>	= day	01 to 31
<i>hh</i>	= hour	00 to 23
<i>mm</i>	= minute	00 to 59
<i>ss</i>	= second	00 to 59



Recommended Setting. Set using the DVS Software.

**Example** TS12/06/17, 13:15:00 sets the real-time clock to 1:15:00 pm, June 17, 2012.



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.

# Water Profiling Commands

The following commands define the criteria used to collect the water-profile data.

## Available Water Profiling Commands

This section lists the available Water Profiling commands.

```
>w?
Available Commands:
WB 0----- Bandwidth
WD 111100000 ----- Data Out {v;c;i;a;p;s;i;*;*;*;*}
WF 0100 ----- Blanking Distance (cm)
WN 005 ----- Number of Bins [1-5]
WP 001 ----- Number of Pings [1-999]
WS 0025 ----- Bin Size (cm)
W? ----- Display W-Command Menu

>
```

## Water Profiling Command Descriptions

### WB – Bandwidth

Purpose	Sets the profiling mode bandwidth and sampling rate. Smaller bandwidths allow the DVS to profile farther, but the standard deviation is increased by as much as 2.5 times.
Format	WB <i>n</i>
Range	<i>n</i> = 0 (Wide), 1 (Narrow)
Default	WB0 (750 meter systems), WB1 (6000 meter systems)



Recommended Setting. This command is set by the DVS software deployment wizard.

Description See table below.

**Table 24: Bandwidth Control**

Bandwidth	Sample rate	Data variance	Profiling range
0 = Wide (25%)	High	Low	Low
1 = Narrow (6.25%)	Low	High	High



The DVS 6000 meter system is primarily deployed into low backscatter waters. Narrow bandwidth uses more transmit power, increasing range, to make up for a reduction in range due to a low backscatter environment at deep depths.

## WD – Data Out

Purpose	Sets the data types that get output when the PDO output format is selected:
Format	WD <i>abc def ghi</i>
Range	Firmware switches (see description)
Default	WD 111 100 000



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

**Description** WD uses firmware switches to tell the DVS the types of data to collect. Valid only when PDO 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:

<i>a</i> = Velocity	<i>d</i> = Percent good	<i>g</i> = Reserved
<i>b</i> = Correlation	<i>e</i> = Status	<i>h</i> = Reserved
<i>c</i> = Echo Intensity	<i>f</i> = Reserved	<i>l</i> = Reserved

**Example** WD 111100000 (default) tells the DVS to collect velocity, correlation magnitude, echo intensity, and percent-good.



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.



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.  
The recommended minimum Blanking Distance for the DVS is 30 cm.



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 Pings

Purpose	Selects the number of pings per ensemble.
Format	WPnnn
Range	nnn = 1 to 999
Default	WP1



Recommended Setting. Set using the DVS Software.

**Description** WP sets the number of pings per ensemble before sending/recording the data.



1. If WP = zero the DVS does not collect water-profile data.
2. The DVS automatically extends the ensemble interval (TE) if  $WP \times TP > TE$ .

## WS – Bin Size

Purpose	Selects the volume of water for one measurement cell.
Format	WSnnn
Range	nnn = 3 to 100 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.

NOTES

# Chapter 9

## OUTPUT DATA FORMAT



In this chapter, you will learn:

- PD20 output data format
- PD0 output data format

This section explains the output data format of the DVS. The DVS is capable of outputting four different data formats, Hex-ASCII in PD0, Hex-ASCII in PD20, Binary in PD20, and Binary in PD0 (Binary in PD0 being the format that TRDI software supports). Hex-ASCII or Binary is selected from the CFXX0XX and CFXX1XX commands, respectively. PD0 or PD20 is selected from the PD command (PD0 command for PD0 output and PD20 command for PD20 output). Hex-ASCII data are twice the size of binary data. When binary data are converted to Hex-ASCII, each 8-bit byte is converted into two 8-bit ASCII bytes. Please note that the PD command governs both output data and recorder data formats. The CF command is independent of the recorder data format as the recorder only records data in binary (i.e.: recorded data can only be in one of two formats, Binary-PD0 or binary-PD20). DVS data in binary-PD20 format can be converted to binary-PD0 format using the *DVS* software.

## 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.



TRDI software reads binary PD0 data. Binary PD20 data may be converted to binary PD0 data in the DVS software. DVS software does not read Hex-ASCII data, whether in PD0 or PD20 form.

## 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.

## PD22 Output Data Format

The default Output Data Format for the DVS is PD22. This command will output ensemble #1 in both PD0 and PD20 formats to the recorder, but only PD20 format to the real-time serial output. All other ensembles are output in PD20 format.

## PD20 Output Data Format

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.



TRDI's software supports binary PD0 formatted data only. Use the *DVS* software to convert binary PD20 data to binary PD0.

<b>HEADER</b> (7 BYTES)
<b>SCALAR DATA</b> (57 BYTES)
<b>CTD DATA</b> (20 BYTES)
<b>ARRAY DATA</b> (20 x # Bins +2)
<b>CHECKSUM</b> (2 BYTES)

**Figure 71. 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 188 bytes per ensemble.

7	BYTES OF HEADER DATA (6 BYTES if no CTD)
57	BYTES OF SCALAR DATA
20	BYTES OF CTD DATA (if included)
102	BYTES OF ARRAY DATA (20 x # Bins +2)
2	BYTES OF CHECKSUM DATA
188	<b>BYTES OF DATA PER ENSEMBLE</b>



If the CTD is not integrated or enabled, there will be 6 bytes of Header Data and the CTD data will not be included.

## PD20 Header Data Format

BYTE	BIT POSITIONS								
	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 CTD DATA								
7	POINTER TO ARRAY DATA								

See Table 25 for a description of the fields.

**Figure 72. 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 25: 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 3
5	Pointer to Scalar Data	0-255	Default will be 7
6	Pointer to CTD data	0-255	Default will be 64
7	Pointer to Array Data	0-255	Default will be 63



If the CTD is not integrated or enabled, there will be 6 bytes of header data and CTD data will not be included.

# PD20 Scalar Data Format

BYTE	BIT POSITIONS							
	7	6	5	4	3	2	1	0
1.	SCALAR DATA ID							
2.								
3.	ENSEMBLE #							
4.								
5.	YEAR							
6.								
7.	MONTH							
8.	DAY							
9.	HOUR							
10.	MINUTE							
11.	SECOND							
12.	TIME BETWEEN PINGS							
13.								
14.	NUMBER OF PINGS							
15.								
16.	BUILT IN TESTS							
17.								
18.								
19.	SENSOR SOURCE							
20.								
21.								
22.	BATTERY VOLTAGE							
23.	AVERAGE HEADING							
24.								
25.	AVERAGE PITCH							
26.								
27.	AVERAGE ROLL							
28.								
29.	RESERVED FOR FUTURE USE							
30.								
31.								
32.	AVERAGE TEMPERATURE							
33.								
34.								

BYTE	BIT POSITIONS							
	7	6	5	4	3	2	1	0
35.	AVERAGE PRESSURE							
36.								
37.								
38.								
39.	STANDARD DEVIATION HEADING							
40.	STANDARD DEVIATION PITCH							
41.	STANDARD DEVIATION ROLL							
42.	RESERVED FOR FUTURE USE							
43.	STANDARD DEVIATION TEMPERATURE							
44.								
45.	STANDARD DEVIATION PRESSURE							
46.								
47.								
48.								
49.	COORDINATE SYSTEM							
50.	BIN SIZE							
51.	BIN 1 DISTANCE							
52.	NUMBER OF ENSEMBLES							
53.								
54.								
55.	NUMBER OF ENSEMBLES							
56.	NUMBER OF ENSEMBLES							
57.	NUMBER OF ENSEMBLES							

**Figure 73. PD20 Scalar Data Format**

Scalar data refers to the non-array data that is not associated with profile cells. Examples are ensemble time, sensor readings, and some command settings. The DVS always sends Scalar data LSBs first.

**Table 26: 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 Pings (s). Set by DVS software in seconds
14-15		Number of pings
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		Reserved
31-34		Average Temp LSB = 0.001 degrees C (-5000 to +45000)
35-38		Average Pressure LSB = 1 Pascal
39-40		Std Dev Heading LSB = 0.01 degrees (0 to 36000). If Heading is bad, value = 32768.
41		Std Dev Pitch LSB = 0.01 degrees (0 to 255). If Pitch is bad, value = 255.
42		Std Dev Roll LSB = 0.01 degrees (0 to 255). If Roll is bad, value = 255.
43-44		Reserved
45-46		Std Dev Temp LSB = 0.001 degrees C (0 to 1000). If Temp is bad, value = 32768.
47-50		Std Dev Pressure LSB = 1 Pascal. If Pressure is bad, value = 2147483648.
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



The transducer orientation can be determine by decoding the BIN 1 DISTANCE bytes 54 and 55 in the Scalar Data Format as a signed number. See [Data Decoding Sequence for Data Format PD20](#).

# PD20 CTD Data Format

BYTE	BIT POSITIONS							
	7	6	5	4	3	2	1	0
1.	CTD DATA ID							
2.	YEAR							
3.	MONTH							
4.	DAY							
5.	HOUR							
6.	MINUTE							
7.	SECOND							
8.	TEMPERATURE							
9.	PRESSURE							
10.	SALINITY							
11.								
12.								
13.								
14.								
15.								
16.								
17.								
18.								
19.								
20.								

**Figure 74. PD20 CTD Data Format**

CTD data is output to PD20 with other data after the last ping of the ensemble. It has the following fields:

**Table 27: PD20 CTD Data Format**

Byte	Value	Description
1	0x83	CTD Data ID
2-3	Year	Date and time of the CTD data.
4	Month	
5	Day	
6	Hour	
7	Minute	
8	Second	
9-12	Temperature	Temperature (round(temp * 10000.0))
13-16	Pressure	Pressure (round (pressure * 1000.0))
17-20	Salinity	Salinity (round(salinity * 10000.0))



The CTD is optional. This data format is only included if the DVS system has a CTD connected and enabled with the S2231 command.

# 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							
↓	<b>Continues for n bins</b>							
$8*N+4*(n-1)+2$	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							
↓	<b>Continues for n bins</b>							
$12*N+4*(n-1)+2$	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							
↓	<b>Continues for n bins</b>							
$16*N+4*(n-1)+2$	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							
↓	<b>Continues for n bins</b>							

**Figure 75. PD20 Array Data Format**

 n = bin number (1 through 5), N = number of bins (1 through 5)

Array data refers to the DVS data that applies to individual profile cells (velocity, amplitude, correlation, and percent-good). The DVS always sends Array data LSBs first.

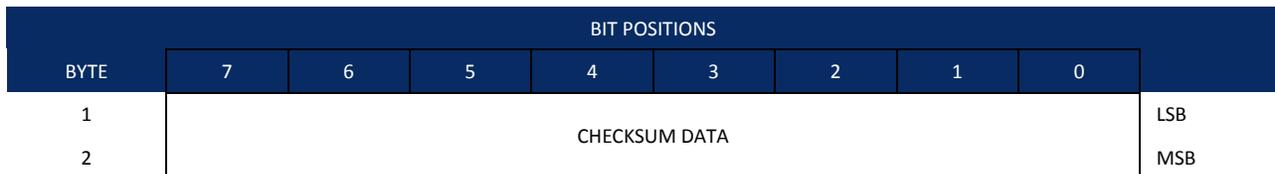
**Table 28: PD20 Array Data Format**

Number of Bytes	Value	Description
1 (Byte 1)	0x82	ID
1 (byte 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%



n = bin number (1 through 5), N = number of bins (1 through 5)  
 Total number of bytes of Array Data = 20\*N+2.

## PD20 Checksum Data Format



**Figure 76. PD20 Checksum Data Format**

**Table 29: PD20 Checksum Data Format**

Byte	Limit	Description
1,2	65535 (0xFFFF)	The DVS computes the checksum by summing all the bytes in the output buffer excluding the checksum, then performing a modulo 65536.

# PD0 Output Data Format

The following description is for the PD0 DVS output data format. Figure 78 through Figure 84 shows the ASCII and binary data formats for the DVS PD0 mode. Table 30 through Table 38 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 30). The fixed and variable leader data is preceded by ID codes 0000 and 8000, (explained in Table 31 and Table 32). 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	<b>HEADER</b> (6 BYTES + [2 x No. OF DATA TYPES])
	<b>FIXED LEADER DATA</b> (59 BYTES)
	<b>VARIABLE LEADER DATA</b> (65 BYTES)
WD command WP command	<b>VELOCITY</b> (2 BYTES + 8 BYTES PER DEPTH CELL)
	<b>CORRELATION MAGNITUDE</b> (2 BYTES + 4 BYTES PER DEPTH CELL)
	<b>ECHO INTENSITY</b> (2 BYTES + 4 BYTES PER DEPTH CELL)
	<b>PERCENT GOOD</b> (2 BYTES + 4 BYTES PER DEPTH CELL)
ALWAYS OUTPUT	<b>RESERVED</b> (2 BYTES)
	<b>CHECKSUM</b> (2 BYTES)

Figure 77. 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)
<b>254</b>	<b>BYTES OF DATA PER ENSEMBLE</b>

# 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 30 for a description of the fields.

**Figure 78. 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 30: 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 84).
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).

# 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	
29	HEADING BIAS							LSB	
30								MSB	
31	SENSOR SOURCE								
32	SENSORS AVAILABLE								
33	BIN 1 DISTANCE								
34									

BIT POSITIONS								
BYTE	7	6	5	4	3	2	1	0
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 31 for a description of the fields  
**Figure 79. 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 31: 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	<p>This field defines the DVS hardware configuration. Convert this field (2 bytes, LSB first) to binary and interpret as follows.</p> <pre> 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)                     </pre>
13,14	7	Real/Sim Flag	This field is set by default as real data (0).
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 36 (Percent-Good Data Format) has more information.
19,20	10	Number of Cells	<p>Contains the number of depth cells over which the DVS collects data (WN-command).</p> <p>Scaling: LSD = 1 depth cell; Range = 1 to 128 depth cells</p>
21-24	11,12	Pings Per Ensemble	<p>Contains the number of pings used in the ensemble.</p> <p>Scaling: LSD = 1 ping; Range = 0 to 16,384 pings</p>
25-28	13,14	Depth Cell Length	<p>Contains the length of one depth cell (WS-command).</p> <p>Scaling: LSD = 1 centimeter; Range = 1 to 6400 cm (210 feet)</p>
29-32	15,16	Blank after Transmit	<p>Contains the blanking distance used by the DVS to allow the transmit circuits time to recover before the receive cycle begins (WF-command).</p> <p>Scaling: LSD = 1 centimeter; Range = 0 to 9999 cm (328 feet)</p>
33,34	17	Signal Processing Mode	Contains the Signal Processing Mode. This field will always be set to 1.

Hex Digit	Binary Byte	Field	Description
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
45,46	23	Minutes	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).
47,48	24	Seconds	
49,50	25	Hundredths	
51,52	26	Coordinate Transform	Contains the coordinate transformation processing parameters (EX-command). These firmware switches indicate how the DVS collected data. <pre> 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 = NOT USED </pre>
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. <pre> 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 </pre> <p>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).</p>
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)
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)

Hex Digit	Binary Byte	Field	Description
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	

# 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 PRESSURE SENSOR								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								

BIT POSITIONS									
BYTE	7	6	5	4	3	2	1	0	
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	RESERVED								MSB
47									
48	PRESSURE								
49									
50									
51	PRESSURE STD DEV								
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 32 for a description of the fields.

**Figure 80. 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 32: 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 <u>does</u> account for leap years.																																																																																				
11,12	6	RTC Month																																																																																					
13,14	7	RTC Day																																																																																					
15,16	8	RTC Hour																																																																																					
17,18	9	RTC Minute																																																																																					
19,22	10	RTC Second																																																																																					
21,22	11	RTC Hundredths																																																																																					
23-24	12	Ensemble # MSB	This field increments each time the Ensemble Number field (bytes 3,4) "rolls over." This allows ensembles up to 16,777,215. See Ensemble Number field above.																																																																																				
25-28	13,14	BIT Result	The DVS outputs an error count in the upper byte, and a fault code in the lower byte. If the error count is greater than 1, then the lower bytes cycles through the different fault codes with each output. A zero value indicates that there are no faults detected.  The possible fault codes for DVS are as follows:																																																																																				
			<table border="1"> <thead> <tr> <th>Hex Code</th> <th>Name</th> <th>Description</th> </tr> </thead> <tbody> <tr><td>01</td><td>DVS Xmit ERR</td><td>DVS Xmit: Transmitter Shutdown</td></tr> <tr><td>02</td><td>DVS High Current</td><td>DVS Xmit: Transmitter Over-Current</td></tr> <tr><td>03</td><td>DVS Low Current</td><td>DVS Xmit: Transmitter Under-Current</td></tr> <tr><td>04</td><td>DVS Low Voltage</td><td>DVS Xmit: Transmitter Under-Voltage</td></tr> <tr><td>10</td><td>DVS Interrupt Missed</td><td>DVS Rcv: One or more samples were missed</td></tr> <tr><td>11</td><td>DVS Interrupt ERR</td><td>DVS Rcv: Problem with receive sampling</td></tr> <tr><td>23</td><td>DVS Pressure Fail</td><td>DVS Pressure: Pressure Sensor Failure</td></tr> <tr><td>29</td><td>DVS Compass SW Init</td><td>DVS Compass: Can't Initialize Driver</td></tr> <tr><td>2A</td><td>DVS Compass HW Init</td><td>DVS Compass: Can't Initialize Device</td></tr> <tr><td>2B</td><td>DVS Compass Start</td><td>DVS Compass: Can't Start Device</td></tr> <tr><td>2C</td><td>DVS Compass Dev Fail</td><td>DVS Compass: Device Not Working</td></tr> <tr><td>2D</td><td>DVS Temp SW Init</td><td>DVS Temperature: Can't Initialize Driver</td></tr> <tr><td>2E</td><td>DVS Temp HW Init</td><td>DVS Temperature: Can't Initialize Device</td></tr> <tr><td>2F</td><td>DVS Temp Dev Fail</td><td>DVS Temperature: Device Not Working</td></tr> <tr><td>30</td><td>DVS Comm UART ERR</td><td>DVS Comm: Failure in UART Communications</td></tr> <tr><td>31</td><td>DVS Comm Timeout ERR</td><td>DVS Comm: Communications Output Timed-out</td></tr> <tr><td>32</td><td>DVS Comm Intr ERR</td><td>DVS Comm: Failure in UART Interrupt</td></tr> <tr><td>33</td><td>DVS Comm Buffer ERR</td><td>DVS Comm: Communications Buffer Failure</td></tr> <tr><td>35</td><td>DVS Comm Buf Tmo ERR</td><td>DVS Comm: Communications Buffer Timed-out</td></tr> <tr><td>3A</td><td>DVS CTD SW Init</td><td>DVS CTD: Can't Initialize Driver</td></tr> <tr><td>3B</td><td>DVS CTD HW Init</td><td>DVS CTD: Can't Initialize Device</td></tr> <tr><td>3C</td><td>DVS CTD Dev Fail</td><td>DVS CTD: Device Not Working</td></tr> <tr><td>50</td><td>DVS RTC Battery</td><td>DVS RTC: Low Battery Voltage</td></tr> <tr><td>52</td><td>DVS RTC Cal</td><td>DVS RTC: Calibration Failure</td></tr> <tr><td>60</td><td>DVS Recorder Mem ERR</td><td>DVS Recorder: Memory Failure</td></tr> <tr><td>66</td><td>DVS Recorder Full</td><td>DVS Recorder: Memory is Full</td></tr> <tr><td>FE</td><td>DVS No Sleep</td><td>DVS Did Not Sleep</td></tr> </tbody> </table>	Hex Code	Name	Description	01	DVS Xmit ERR	DVS Xmit: Transmitter Shutdown	02	DVS High Current	DVS Xmit: Transmitter Over-Current	03	DVS Low Current	DVS Xmit: Transmitter Under-Current	04	DVS Low Voltage	DVS Xmit: Transmitter Under-Voltage	10	DVS Interrupt Missed	DVS Rcv: One or more samples were missed	11	DVS Interrupt ERR	DVS Rcv: Problem with receive sampling	23	DVS Pressure Fail	DVS Pressure: Pressure Sensor Failure	29	DVS Compass SW Init	DVS Compass: Can't Initialize Driver	2A	DVS Compass HW Init	DVS Compass: Can't Initialize Device	2B	DVS Compass Start	DVS Compass: Can't Start Device	2C	DVS Compass Dev Fail	DVS Compass: Device Not Working	2D	DVS Temp SW Init	DVS Temperature: Can't Initialize Driver	2E	DVS Temp HW Init	DVS Temperature: Can't Initialize Device	2F	DVS Temp Dev Fail	DVS Temperature: Device Not Working	30	DVS Comm UART ERR	DVS Comm: Failure in UART Communications	31	DVS Comm Timeout ERR	DVS Comm: Communications Output Timed-out	32	DVS Comm Intr ERR	DVS Comm: Failure in UART Interrupt	33	DVS Comm Buffer ERR	DVS Comm: Communications Buffer Failure	35	DVS Comm Buf Tmo ERR	DVS Comm: Communications Buffer Timed-out	3A	DVS CTD SW Init	DVS CTD: Can't Initialize Driver	3B	DVS CTD HW Init	DVS CTD: Can't Initialize Device	3C	DVS CTD Dev Fail	DVS CTD: Device Not Working	50	DVS RTC Battery	DVS RTC: Low Battery Voltage	52	DVS RTC Cal	DVS RTC: Calibration Failure	60	DVS Recorder Mem ERR	DVS Recorder: Memory Failure	66	DVS Recorder Full	DVS Recorder: Memory is Full	FE	DVS No Sleep	DVS Did Not Sleep
Hex Code	Name	Description																																																																																					
01	DVS Xmit ERR	DVS Xmit: Transmitter Shutdown																																																																																					
02	DVS High Current	DVS Xmit: Transmitter Over-Current																																																																																					
03	DVS Low Current	DVS Xmit: Transmitter Under-Current																																																																																					
04	DVS Low Voltage	DVS Xmit: Transmitter Under-Voltage																																																																																					
10	DVS Interrupt Missed	DVS Rcv: One or more samples were missed																																																																																					
11	DVS Interrupt ERR	DVS Rcv: Problem with receive sampling																																																																																					
23	DVS Pressure Fail	DVS Pressure: Pressure Sensor Failure																																																																																					
29	DVS Compass SW Init	DVS Compass: Can't Initialize Driver																																																																																					
2A	DVS Compass HW Init	DVS Compass: Can't Initialize Device																																																																																					
2B	DVS Compass Start	DVS Compass: Can't Start Device																																																																																					
2C	DVS Compass Dev Fail	DVS Compass: Device Not Working																																																																																					
2D	DVS Temp SW Init	DVS Temperature: Can't Initialize Driver																																																																																					
2E	DVS Temp HW Init	DVS Temperature: Can't Initialize Device																																																																																					
2F	DVS Temp Dev Fail	DVS Temperature: Device Not Working																																																																																					
30	DVS Comm UART ERR	DVS Comm: Failure in UART Communications																																																																																					
31	DVS Comm Timeout ERR	DVS Comm: Communications Output Timed-out																																																																																					
32	DVS Comm Intr ERR	DVS Comm: Failure in UART Interrupt																																																																																					
33	DVS Comm Buffer ERR	DVS Comm: Communications Buffer Failure																																																																																					
35	DVS Comm Buf Tmo ERR	DVS Comm: Communications Buffer Timed-out																																																																																					
3A	DVS CTD SW Init	DVS CTD: Can't Initialize Driver																																																																																					
3B	DVS CTD HW Init	DVS CTD: Can't Initialize Device																																																																																					
3C	DVS CTD Dev Fail	DVS CTD: Device Not Working																																																																																					
50	DVS RTC Battery	DVS RTC: Low Battery Voltage																																																																																					
52	DVS RTC Cal	DVS RTC: Calibration Failure																																																																																					
60	DVS Recorder Mem ERR	DVS Recorder: Memory Failure																																																																																					
66	DVS Recorder Full	DVS Recorder: Memory is Full																																																																																					
FE	DVS No Sleep	DVS Did Not Sleep																																																																																					
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																																																																																				

Hex Digit	Binary Byte	Field	Description
33-36	17,18	Depth of pressure sensor	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 65535 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 = -70.00° to +70.00°
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 DVSSs, positive values mean that Beam #2 is spatially higher than Beam #1. For down-facing DVSSs, positive values mean that Beam #1 is spatially higher than Beam #2. Scaling: LSD = 0.01 degree; Range = -70.00° to +70.00°
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	29	MPT minutes	This field contains the <u>Minimum Pre-Ping Wait Time</u> between ping groups in the ensemble.
59,60	30	MPT seconds	
61,62	31	MPT hundredths	
63,64	32	Hdg Std Dev	These fields contain the standard deviation (accuracy) of the heading and tilt angles from the gyrocompass/pendulums. Scaling (Heading): LSD = 1°; Range = 0 to 180° Scaling (Tilts): LSD = 0.1°; Range = 0.0 to 20.0°
65,66	33	Pitch Std Dev	
67,68	34	Roll Std Dev	
69-70	35	ADC Channel 0	Reserved
71-72	36	ADC Channel 1	Battery Voltage (in the same format as the Battery Voltage output in PD20)
73-74	37	ADC Channel 2	Reserved
75-76	38	ADC Channel 3	Reserved
77-78	39	ADC Channel 4	Reserved
79-80	40	ADC Channel 5	Reserved
81-82	41	ADC Channel 6	Reserved
83-84	42	ADC Channel 7	Reserved
85-86	43	Error Status Word	The Error Status Word is not used and the DVS always outputs zeros.
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 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

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
93-96	47-48	Reserved	Reserved for TRDI use.
97-104	49-52	Pressure	Contains the pressure of the water at the DVS end-cap relative to one atmosphere (sea level). This value is read from a pressure sensor. Output is in deca-pascals.  Scaling: LSD = 1 deca-pascal; Range = 0 to ±2147483648 deca-pascals.
105-112	53-56	Press Std Dev	Contains the variance (deviation about the mean) of the pressure sensor data. Output is in deca-pascals. The Pressure Sensor Variance is only output if the DVS is <u>not</u> sleeping between pings. If sleeping, then only one sample is taken during each ensemble (on the first ping), so a variance cannot be calculated.  Scaling: LSD = 1 deca-pascal; Range = 0 to ±2147483648 deca-pascals.
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 <u>does</u> account for leap years.
117-118	59	RTC Year	
119-120	60	RTC Month	
121-122	61	RTC Day	
123-124	62	RTC Hour	
125-126	63	RTC Minute	
127-128	64	RTC Seconds	
129-130	65	RTC Hundredths	

# Velocity Data Format

BYTE	BIT POSITIONS								
	7/S	6	5	4	3	2	1	0	
1	VELOCITY ID								LSB 00h
2									MSB 01h
3	DEPTH CELL #1, VELOCITY 1								LSB
4									MSB
5	DEPTH CELL #1, VELOCITY 2								LSB
6									MSB
7	DEPTH CELL #1, VELOCITY 3								LSB
8									MSB
9	DEPTH CELL #1, VELOCITY 4								LSB
10									MSB
11	DEPTH CELL #2, VELOCITY 1								LSB
12									MSB
13	DEPTH CELL #2, VELOCITY 2								LSB
14									MSB
15	DEPTH CELL #2, VELOCITY 3								LSB
16									MSB
17	DEPTH CELL #2, VELOCITY 4								LSB
18									MSB
↓	(SEQUENCE CONTINUES FOR UP TO 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 33 for description of fields

**Figure 81. Velocity Data Format**



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 33: 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.

## Correlation Magnitude, Echo Intensity, and Percent-Good Data Format

BYTE	BIT POSITIONS								LSB
	7/S	6	5	4	3	2	1	0	
1	ID CODE								
2									
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 34 through Table 36 for a description of the fields.

**Figure 82. Binary Correlation Magnitude, Echo Intensity, and Percent-Good Data Format**

 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 34: 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 35: 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 5 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.

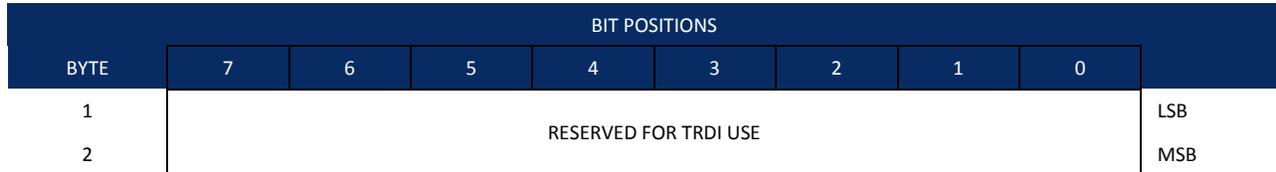
**FIELD 4 – Percentage of good 4-beam solutions** – 45% of the velocity data collected during the ensemble for depth cell 5 were calculated using four beams.

**Table 36: 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.

Hex Digit	Binary Byte	Field	Description
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.

## Binary Reserved BIT Data Format



**Figure 83. Binary Reserved BIT Data Format**

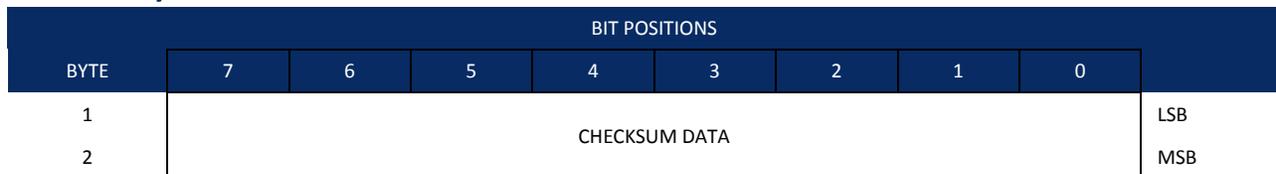


This data is always output. See Table 37 for a description of the fields.

**Table 37: 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).

## Binary Checksum Data Format



**Figure 84. Binary Checksum Data Format**



This data is always output. See Table 38 for a description of the fields.

**Table 38: 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.

# How to Decode a DVS Ensemble

Use the following information to help you write your own software.

## Data Decoding Sequence for Data Format PD20

As an example, to decode the BIN 1 DISTANCE from your PD20 file manually, you first have to find the beginning of the first ensemble which starts with 7F 8Ah.

```

DVS_0000_000000_UP.p20  DVS_0000_000000_DOWN.p20
Offset(h) 00 01 02 03 04 05 06 07 08 09 0A 0B 0C 0D 0E 0F
00000000 7F 8A A5 02 06 3F 81 01 00 00 DB 07 01 12 0F 0C .šŸ.[]?...ô....
00000010 1E 00 00 01 00 00 00 01 11 01 01 57 65 14 4D 00 .....We.M.
00000020 37 00 00 80 A8 61 00 00 00 00 00 80 00 00 00 00 7..€"a.....€...
00000030 00 80 00 00 00 00 00 80 1F 19 00 80 00 01 00 82 ..€.....€...€...
00000040 05 00 80 00 80 00 80 00 80 00 80 00 80 00 80 00 ..€..€..€..€..€..
00000050 80 00 80 00 80 00 80 00 80 00 80 00 80 00 80 00 €.€..€..€..€..€..
00000060 80 00 80 00 80 00 80 00 80 3B 3F 2E 3C 3D 3F 2E €.€..€..€.;?.<=?
00000070 3C 3C 3F 2F 3E 3B 40 2E 3C 3B 3E 2E 3D 0B 14 17 <<?/>;@.<?>.=...
00000080 22 18 14 14 20 11 0A 17 0A 16 12 16 1D 1D 16 22 "...d....."
00000090 23 00 00 64 00 00 00 64 00 00 00 64 00 00 00 64 #.d...d...d...d
000000A0 00 00 00 64 00 8D 1B 7F 8A A5 02 06 3F 81 02 00 ...d...šŸ.[]?...
000000B0 00 DB 07 01 12 0F 0C 1E 00 00 01 00 00 00 01 11 .ô.....
000000C0 01 01 57 66 14 4E 00 37 00 00 80 A8 61 00 00 00 ..Wf.N.7..€"a....
000000D0 00 00 80 00 00 00 00 00 80 00 00 00 00 00 80 1F ..€.....€...
000000E0 19 00 80 00 01 00 82 05 00 80 00 80 00 80 00 80 ..€...€.€..€..€..
000000F0 00 80 00 64 00 00 80 00 00 80 00 80 00 80 00 80 ..€..€..€..€..€..€..
00000100 00 80 00 80 00 80 00 80 00 80 00 80 00 80 00 80 ..€..€..€..€..€..€..
    
```

Then, based on the Header table you can find the Pointer to the Scalar Data where the BIN 1 DISTANCE is coded by moving 4 bytes forward from 7Fh.

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								
↓	↓								↓

Which in this example gets us to Byte 04h.

```

DVS_0000_000000_UP.p20  DVS_0000_000000_DOWN.p20
Offset(h) 00 01 02 03 04 05 06 07 08 09 0A 0B 0C 0D 0E 0F
00000000 7F 8A A5 02 06 3F 81 01 00 00 DB 07 01 12 0F 0C .šŸ.[]?...ô....
00000010 1E 00 00 01 00 00 00 01 11 01 01 57 65 14 4D 00 .....We.M.
00000020 37 00 00 80 A8 61 00 00 00 00 00 80 00 00 00 00 7..€"a.....€...
00000030 00 80 00 00 00 00 00 80 1F 19 00 80 00 01 00 82 ..€.....€...€...
00000040 05 00 80 00 80 00 80 00 80 00 80 00 80 00 80 00 ..€..€..€..€..€..
00000050 80 00 80 00 80 00 80 00 80 00 80 00 80 00 80 00 €.€..€..€..€..€..
00000060 80 00 80 00 80 00 80 00 80 3B 3F 2E 3C 3D 3F 2E €.€..€..€.;?.<=?
00000070 3C 3C 3F 2F 3E 3B 40 2E 3C 3B 3E 2E 3D 0B 14 17 <<?/>;@.<?>.=...
00000080 22 18 14 14 20 11 0A 17 0A 16 12 16 1D 1D 16 22 "...d....."
00000090 23 00 00 64 00 00 00 64 00 00 00 64 00 00 00 64 #.d...d...d...d
000000A0 00 00 00 64 00 8D 1B 7F 8A A5 02 06 3F 81 02 00 ...d...šŸ.[]?...
    
```

There, the pointer value found is 06, which means the beginning of the Scalar Data is 06h bytes forward from the beginning of the ensemble marked by 7Fh.

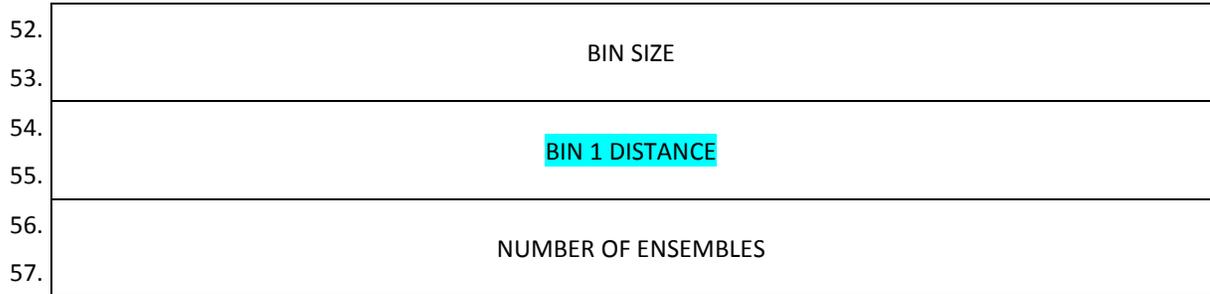
Since in this example 7Fh is positioned at 00h then the beginning of the Scalar Data is at 00h + 06h = 06h:

```

DVS_0000_000000_UP.p20  DVS_0000_000000_DOWN.p20
Offset (h) 00 01 02 03 04 05 06 07 08 09 0A 0B 0C 0D 0E 0F
00000000 7F 8A A5 02 06 3F 51 01 00 00 DB 07 01 12 0F 0C .š¥...?ú.....
00000010 1E 00 00 01 00 00 00 01 11 01 01 57 65 14 4D 00 .....We.M.
00000020 37 00 00 80 A8 61 00 00 00 00 00 00 80 00 00 00 00 7..e"a.....e...
00000030 00 80 00 00 00 00 00 80 1F 19 00 80 00 01 00 82 ..e.....e...
00000040 05 00 80 00 80 00 80 00 80 00 80 00 80 00 80 00 00 e.e.e.e.e.e.e.e.
00000050 80 00 80 00 80 00 80 00 80 00 80 00 80 00 80 00 00 e.e.e.e.e.e.e.e.
00000060 80 00 80 00 80 00 80 00 80 3B 3F 2E 3C 3D 3F 2E e.e.e.e.e.;?.<=?
00000070 3C 3C 3F 2F 3E 3B 40 2E 3C 3B 3E 2E 3D 0B 14 17 <<?/>;@.<?>.=...
00000080 22 18 14 14 20 11 0A 17 0A 16 12 16 1D 1D 16 22 "... .."
00000090 23 00 00 64 00 00 00 64 00 00 00 64 00 00 00 64 #.d....d....d
    
```

The Scalar Data first byte is a fixed header of value 81h.

Now, to find the BIN 1 DISTANCE we need to move forward by 53 bytes forward from the beginning of the Scalar Data based on the table below:



**PD20 Scalar Data Format**

First, convert 53 decimal to hexadecimal; 53 = 35h when converted. This means we need to go to byte 06h + 35h = 3Bh. The value of BIN 1 DISTANCE in this example is coded in 3B 3Ch.

```

DVS_0000_000000_UP.p20  DVS_0000_000000_DOWN.p20
Offset (h) 00 01 02 03 04 05 06 07 08 09 0A 0B 0C 0D 0E 0F
00000000 7F 8A A5 02 06 3F 81 01 00 00 DB 07 01 12 0F 0C .š¥...?ú.....
00000010 1E 00 00 01 00 00 00 01 11 01 01 57 65 14 4D 00 .....We.M.
00000020 37 00 00 80 A8 61 00 00 00 00 00 80 00 00 00 00 00 7..e"a.....e...
00000030 00 80 00 00 00 00 00 80 1F 19 00 80 00 01 00 82 ..e.....e...
00000040 05 00 80 00 80 00 80 00 80 00 80 00 80 00 80 00 00 e.e.e.e.e.e.e.e.
00000050 80 00 80 00 80 00 80 00 80 00 80 00 80 00 80 00 00 e.e.e.e.e.e.e.e.
00000060 80 00 80 00 80 00 80 00 80 3B 3F 2E 3C 3D 3F 2E e.e.e.e.e.;?.<=?
00000070 3C 3C 3F 2F 3E 3B 40 2E 3C 3B 3E 2E 3D 0B 14 17 <<?/>;@.<?>.=...
00000080 22 18 14 14 20 11 0A 17 0A 16 12 16 1D 1D 16 22 "... .."
00000090 23 00 00 64 00 00 00 64 00 00 00 64 00 00 00 64 #.d....d....d
000000A0 00 00 00 64 00 8D 1B 7F 8A A5 02 06 3F 81 02 00 ...d....š¥...?....
    
```

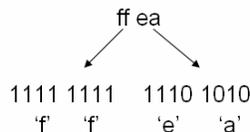
In this example we obtain 80 00 or 0080h.

To decode the BIN 1 DISTANCE:

First note that BIN 1 DISTANCE is a 2s-complement signed variable.

Let's assume the BIN 1 DISTANCE that you try to decode is ea ff in the binary raw data. Since the format is LSB (Byte 54) MSB (Byte 55), read BIN 1 DISTANCE (Hex ASCII) = ff ea.

Let's transform both hexadecimal bytes into two binary bytes:



The Most Significant Bit (i.e. the first bit on the left of the binary word) will decide the sign of the variable.

Shown below is a formula that you can apply to obtain the decimal value of the BIN 1 DISTANCE using the above binary word:

$$\text{Decimal BIN 1 DISTANCE} = [(-1)^X \times (\text{decimal}(X000\ 0000\ 0000\ 0000)) + (\text{decimal}(YYY\ YYYYY\ YYYYY\ YYYYY))] \times \text{Scale factor}$$

Where the binary word is:

XYYY YYYY YYYY YYYY

Using this formula in this example, we obtain:

X = 1

Y....Y = 111 1111 1110 1010

Scale Factor (See data type description in the DVS Operational guide) = 1cm

Thus,

$$\text{Decimal BIN 1 DISTANCE} = [(-1)^1 \times (\text{decimal}(1000\ 0000\ 0000\ 0000)) + (\text{decimal}(111\ 1111\ 1110\ 1010))] \times 1\text{cm}$$

Decimal BIN 1 DISTANCE = [-32768 + 32746] x 1cm

Decimal BIN 1 DISTANCE = -22 cm which means the Transducer is looking **Down**.

Transducer Orientation	Up	Down
PD20 BIN 1 DISTANCE sign	+	-



Once converted from PD20 to PDO using the DVS software, the transducer orientation is coded in the SYSTEM CONFIGURATION bytes 5 and 6 in the [PDO Fixed Leader](#) data.

## Rules for the BroadBand Data Format PDO

1. 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 39: 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

2. 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 "3".
3. 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).
4. 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.

5. The header data will include the number of data types in the files and the offset to each ID number for each data type.
6. The total number of the bytes in an ensemble minus the 2-byte checksum will be included in the header.

## Recommended Data Decoding Sequence for Broad-Band Data Format PDO

1. Locate the header data by locating the header ID number (in the case of PDO profile data that will be 7F7F).
2. Confirm that you have the correct header ID by:
  - a. Locating the total number of bytes (located in the header data) in the ensemble. This will be your offset to the next ensemble.
  - b. 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.
  - c. Read the 2-byte checksum word at the end of the ensemble, located by using the checksum offset in the header (determined in step “2-a”) and compare this checksum word to the value calculated in step “2-b”.
  - d. 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 “1” and search for the next header ID number occurrence.
3. Locate the number of data types (located in the header data).
4. Locate the offset to each data type (located in the header data).
5. 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.
6. 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.

NOTES

# Appendix **A**

## SEA-BIRD ELECTRONICS INDUCTIVE MODEM MODULE



In this chapter, you will learn:

- What equipment you need
- IMM communication setup
- Using the DVS commands CO, CW, or CV
- Using the gdata formalism

Teledyne RD Instruments' low-power Doppler Volume Sampler (DVS) is ideally suited for long-term shallow or deep-water moored current measurement applications. The DVS can provide substantially improved data quality over traditional single point solutions, allowing for up to 5 bins of velocity data over a range of up to 3 m nominal, 5m maximum. The DVS offers proven precision and reliability that Teledyne RDI is known for.

It is recommended that a Sea-Bird Electronics Inductive Modem Module (SBE IMM) be used as the surface modem when integrating a DVS with inductive modem.



Figure 85. SBE IMM

However, there are some circumstances in which the older SBE Surface Inductive Modem (SBE SIM) may be the more convenient and/or economical option.

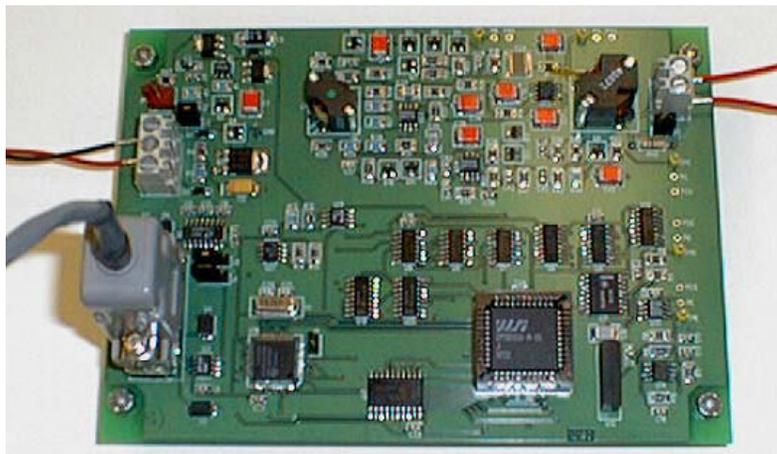


Figure 86. SBE SIM

It is important to note that the DVS was designed around binary communications, which the older SIM does not support. In order to enable communication between the SBE SIM and the DVS, the DVS's IMM must be reconfigured.

This appendix addresses the process required for establishing communication between a SBE SIM and a DVS with SBE IMM.

## Equipment needed:

- Sea-Bird SIM (bare-board is assumed)
- RS232 communications cable
- DVS equipped with IMM
- 9 VDC power supply
- Shielded conductor at least 2 m in length.
- Computer with a least one available serial port
- A terminal emulator such as *BBTalk* or *HyperTerminal*.

## Connections

1. Connect JP2 on the SIM to the computer serial port using the RS232 communications cable.
2. Connect one end of the 2 m shielded connector to one pin of JP4 on the SIM, loop the conductor through the IMM coupler on the DVS, and connect the other end of the shielded conductor to the other pin of JP4 on the SIM. The SIM and DVS should be located ~ 1m or more apart to avoid interference.
3. Connect power supply to the SIM on JP1 pins 1 and 2.

## Establish Communications between the SIM and IMM

- a. On the host computer open the terminal emulator program.
- b. Apply (or cycle) power to the SIM, which should respond with:

```
S>SBE 37 SURFACE MODEM V 3.0
sending wake up tone, wait 4 seconds
```

```
S>
```

1. The S prompt is from the surface modem. Establish the ID of the IMM on the line by sending: `id?` (if using *HyperTerminal*, send `id?<ctrl-m><ctrl-j>`), you should see something like:

```
S>id?
id = 00
S>
```

2. In this case, the IMM modem id was never set, and so remains the default of 00. To speak directly to the IMM in the DVS (not the DVS itself) all commands should be preceded by !00 (or whatever ID number was returned by the `id?` command).
3. It is assumed that the DVS IMM has been configured by the DVS software. To verify that this is the case, send `!00getcd` (or `!00getcd<ctrl-m><ctrl-j>` if using *HyperTerminal*) and you should see the following response:

```
S>!00getcd
<ConfigurationData DeviceType='SBE90554 IMM' SerialNumber='70000142'>
<Settings ConfigType='2'
DebugLevel='0'
BaudRate='9600'
HostID='Host ID not set'
GdataStr='cw'
HostPrompt='x'
Note: it is not important that this is cw here
```

```

ModemPrompt=' IMM> '
DeviceID=' 0 '
EnableHostFlagWakeup=' 0 '
EnableHostFlagConfirm=' 0 '
EnableHostFlagTerm=' 0 '
EnableSerialIMMWakeup=' 0 '
EnableHostPromptConfirm=' 0 '
EnableHostServeOnPwrup=' 0 '
EnableAutoIMFlag=' 1 '
EnablePrompt=' 0 '
EnableHostWakeupCR=' 0 '
EnableHostWakeupBreak=' 0 '
EnableEcho=' 0 '
EnableSignalDetector=' 1 '
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 '
TMODEM4=' 100 '
/>
</ConfigurationData>
S>

```

## Configuring the IMM to communicate with DVS via the older SIM.

1. The SIM can not work with binary data, so send `!00setenablebinarydata=0<cr>` or `!00setenablebinarydata=0<ctrl-m><ctrl-j>` if using *HyperTerminal*.
2. The SIM will not pass carriage returns to the IMM, which the DVS needs to recognize that a command has been sent. The IMM can be configured to append a carriage return to commands it passes to DVS by sending it the command: `!00settermtohost=13<cr>` (`!00settermtohost=12<ctrl-m><ctrl-j>` in *HyperTerminal*).

## Inductive Communication with the DVS

1. Commands preceded with `!00` are commands intended for IMM id number 00, commands preceded with `#00` are commands that IMM id number 00 should relay to its host (the DVS).
2. Assuming the DVS is not deployed, wake the DVS by telling the IMM to send a hard break: `!00sendbreak<cr>` (`!00sendbreak<ctrl-m><ctrl-j>` in *HyperTerminal*).
3. You should now be able to communicate directly with DVS using any DVS command. For example:

```
S>!00sendbreak
```



# Configuring the DVS to use the gdata formalism

One of the three commands CO, CW or CV must be chosen to use with the gdata command. For our purposes, let's assume it is to be CW. Send the following commands to the DVS IMM

`!00setgdatastr=cw<cr>` (`!00setgdatastr=cw<ctrl-m><ctrl-j>` in *HyperTerminal*). This sets the command that the IMM is to send to the DVS whenever the gdata command is sent. It is here set to be cw (download the last ensemble gathered).

`!00setenablegdatatosample=1<cr>` (`!00setenablegdatatosample<ctrl-m><ctrl-j>` in *HyperTerminal*). This tells the IMM to load the DVS response to the gdata command into its buffer.

To use the gdata formalism the DVS must have been deployed. To use the gdata send:

1. `Gdata<cr>` (`gdata<ctrl-m><ctrl-j>` in *HyperTerminal*). This command tells all of the instruments on the line to execute their pre-programmed gdata commands.
2. `!00samplegetlast<cr>` (`!00samplegetlast<ctrl-m><ctrl-j>` in *HyperTerminal*). This tells modem id number 00 to upload its last sample to the SIM.
3. `#00cz<cr>` (`#00cs<ctrl-m><ctrl-j>` in *HyperTerminal*). This puts the DVS back to sleep

# Appendix **B**

## NOTICE OF COMPLIANCE



In this chapter, you will learn:

- China RoHS requirements
- Material disclosure table

## 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.

## 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 40.

## 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 the unit 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

## 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.

# 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 40. Toxic or Hazardous Substances and Elements Contained in Product**

零件□目(名称) Component Name	有毒有害物□或元素 Toxic or Hazardous Substances and Elements					
	□ Lead (Pb)	汞 Mercury (Hg)	□ Cadmium (Cd)	六价□ Hexavalent Chromium (Cr <sup>6+</sup> )	多溴□苯 Polybrominated Biphenyls (PBB)	多溴二苯□ Polybrominated Diphenyl Ethers (PBDE)
□能器配件 Transducer Assy.	X	X	O	X	O	O
接收机□路板/数据□理器□路板 Receiver PCB/ DSP PCB	O	O	O	O	O	O
微□理器□路板/□入□出□路板 CPU PCB/PIO PCB	O	O	O	O	O	O
机体装配 Housing Assy.	O	O	O	O	O	O
底座装配 End-Cap Assy.	O	O	O	O	O	O
□池□ Battery Pack	O	O	O	O	O	O
交流□□□器 AC Voltage Adapter	O	O	O	O	O	O
水下专用电缆 Underwater Cable	O	O	O	O	O	O
□用装运箱和泡沫塑料□ Shipping Case w/Foam	O	O	O	O	O	O

**O:** 表示□有毒或有害物□在□部件所有均□材料中的含量均在 SJ/T 11363-2006 □准□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□有毒或有害物□至少在□部件的某一均□材料中的含量超出 SJ/T 11363-2006 □准□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.

NOTES