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Argonaut-ADV
Operation Manual
Firmware Version 11.2

WARRANTY, TERMS, AND CONDITIONS

Thank you for purchasing a SonTek Argonaut-ADV. The instrument was thoroughly tested at the factory and found to be in excellent working condition. If the shipping crate appears damaged, or if the system is not operating properly, please contact SonTek immediately.

The system you have purchased is covered under a one year limited warranty that extends to all parts and labor for any malfunction due to workmanship or errors in the manufacturing process. The warranty does not cover shortcomings that are due to the design, nor does it cover any form of incidental damage as a result of errors in the measurements.

In case your system is not functioning properly, first try to identify the source of the problem (see the appropriate section of the manual for a trouble shooting advice). If additional support is required, we encourage you to contact us immediately if a problem is detected and we will work to resolve the problem as quickly as possible. Most problems can be resolved without a system being returned to us.

In case the system needs to be shipped back to the factory, please contact SonTek to obtain a Return Merchandise Authorization (RMA) number. We reserve the right to refuse receipt of shipments without RMAs. We require the system to be shipped back in original shipping container using original packing material and all delivery cost to SonTek covered by the customer (including all taxes and duties). If the system is returned without appropriate packing, the customer will be required to cover the cost of a new packaging crate and material.

INTRODUCTION

This manual is organized into the following sections:

- **Section 1. Argonaut-ADV Components, Terminology, and Sampling –** Definition of terms used in this manual, plus a general description of Argonaut-ADV sampling.
- **Section 2. Getting Started –** Instructions for collecting data with the Argonaut-ADV in the most-common configurations.
- **Section 3. Direct-Command Interface –** Direct serial communication with the Argonaut-ADV using a terminal or terminal emulator.
- **Section 4. Compass/Tilt Sensor Operation**
- **Section 5. Argonaut-ADV Hardware –** Description of Argonaut-ADV electronics, cables, connectors, and instructions for accessing system components.
- **Section 6. Operational Considerations –** Concerns relating to power supply, instrument mounting, coordinate systems, maintenance, and troubleshooting.
- **Section 7. Real-Time Deployment –** Instructions for initiating an autonomous deployment (using internal recording and battery power). This section also includes detailed information on Argonaut-ADV power consumption and data storage requirements, and a general discussion of operating parameter selection.
- **Section 8. Autonomous Deployment –** Instructions for operating from battery power and using the internal recorder.
- **Section 9. Optional External Sensors –** Concerns relating to optional external sensors (CTD, YSI, analog sensors).
- **Section 10. Additional Support**
- **Appendix A. Argonaut-ADV Binary Data File Format**
- **Appendix B. Multiple Argonaut-ADV Operation using RS485**
- **Appendix C. SDI-12 Operation**

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Section 1. Argonaut-ADV Components, Terminology, and Sampling

1-1. System Components

There are three main Argonaut-ADV configurations.

- **Argonaut-ADV Underwater Configuration –** This configuration (Figure 1) uses a submersible housing for all system electronics: receiver, processor, recorder, and compass/tilt sensor. The system operates on externally supplied power.
- **Argonaut-ADV Autonomous Configuration –** This is the Underwater Configuration with the addition of internal batteries. The system is identical to the one shown in Figure 1, but with a longer housing to accommodate batteries. The autonomous system can be configured with alkaline or rechargeable (NiCad) batteries depending on the application.
- **Argonaut-ADV Splash-Proof Configuration –** This system separates the receiver electronics (in a smaller submersible housing) from the processor (in a separate splash-proof housing). The two are connected by the probe cable. This system is primarily designed for wading rod applications, and is shown in Figure 2.

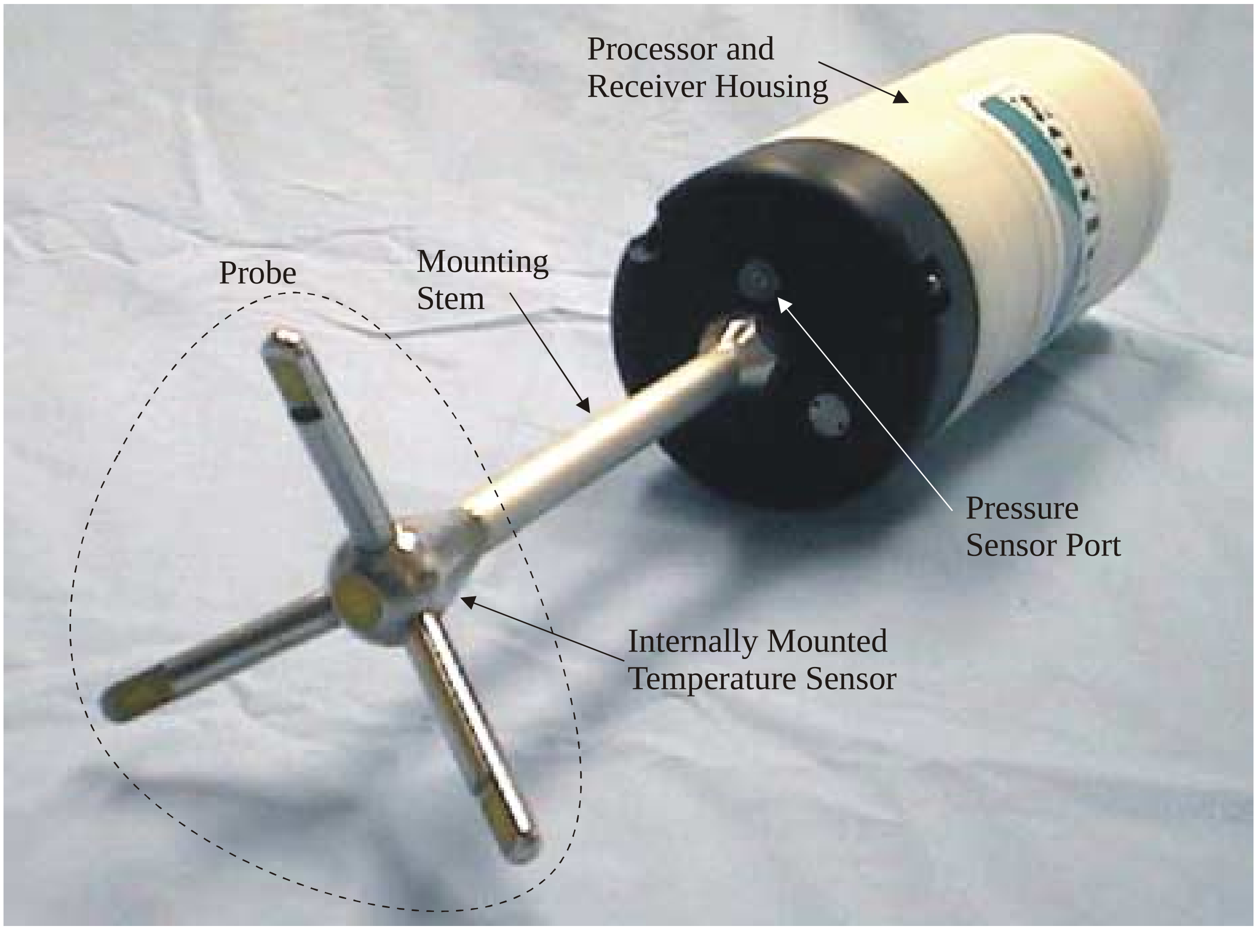

Figure 1 – Argonaut-ADV Underwater Configuration

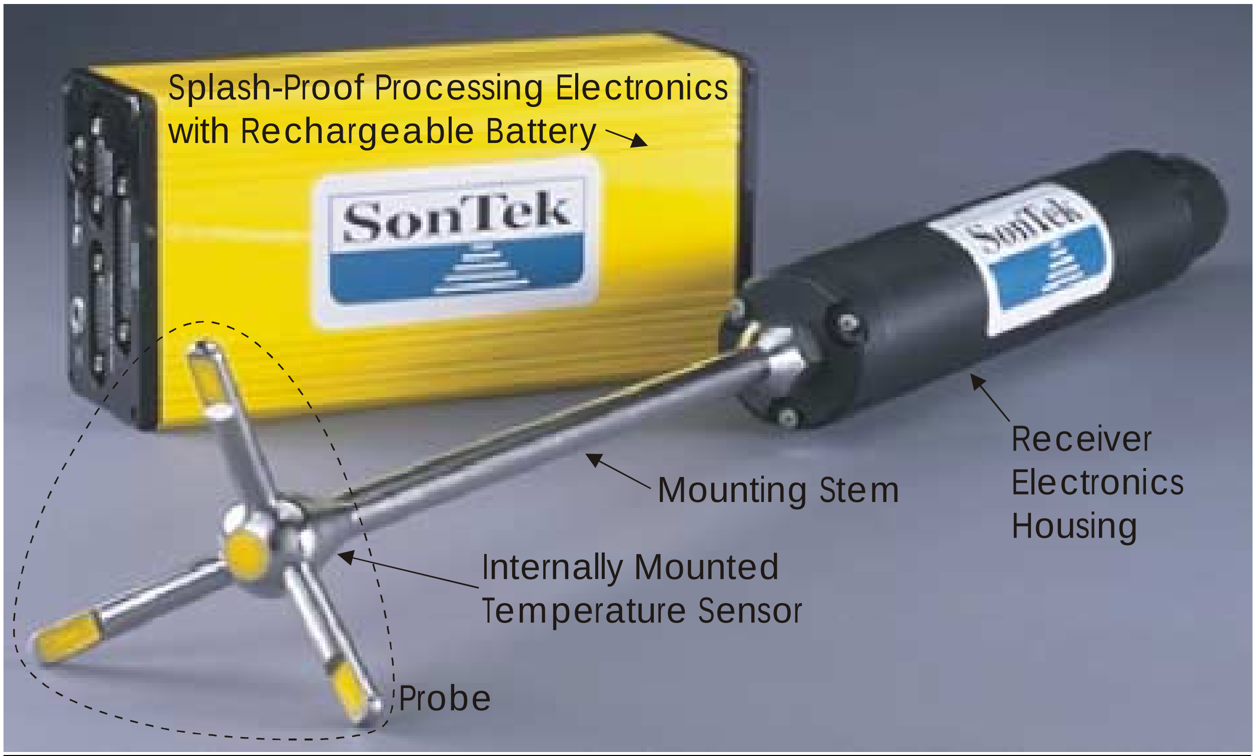

Figure 2 – Argonaut-ADV Splash-Proof Configuration

The following terms are used regularly when referring to the Argonaut-ADV.

- **Probe –** The probe consists of one transmitter and two or three receivers (for 2D or 3D measurements). Probe components and functions are shown in Figure 3. See §6-4 and the *Argonaut-ADV Principles of Operation* for different probe configurations.
- **Mounting stem** – The probe is mounted either on a rigid metal stem (15 or 25 cm in length) or on a 1-m flexible cable (with a rigid stem at the probe end).
- **Receiver –** The receiver electronics amplify and filter signals to/from the probe. In the underwater system, the receiver is in the same housing as the processor (Figure 1). In the splash-proof system, the receiver electronics are in a separate housing (Figure 2).
- **Processor –** The Argonaut-ADV processor consists of two printed circuit boards that perform all Doppler velocity processing. In the underwater system, the boards are installed in the same submersible housing as the receiver electronics (Figure 1). In the splash-proof system, they are installed in a separate housing (non-submersible) that includes a rechargeable battery (Figure 2).
- **Probe cable** – For the splash-proof system, a multi-conductor shielded cable connects the probe and receiver to the processor. This cable is very noise-sensitive; it should never be modified. The maximum probe cable length is 30 m (the cable is not shown in Figure 2). The underwater system does not have a probe cable.

- **Power and communication cable –** For the underwater system, a single cable carries DC power and serial communication between the processor and the controlling computer/data logger. For the splash-proof system, separate cables are used for power and serial communication. Details: §3-1 for serial communication protocols used by the Argonaut-ADV.
- **Temperature sensor –** The temperature sensor is internally mounted in the probe. Temperature data is used to compensate for changes in sound speed; sound speed is used to convert Doppler shift to water velocity. Details: §6-6 for temperature sensor; *Argonaut-ADV Principles of Operation* for the effect of sound speed on velocity data.
- **Compass/tilt sensor –** This optional sensor (available only with the underwater system) measures magnetic heading and 2-axis tilt (maximum tilt ±50°). It allows the Argonaut-ADV to report velocity measurements in Earth coordinates (East/North/Up or ENU). Details: Section 4.
- **Pressure sensor –** This optional sensor (available only with the underwater system) is mounted in the probe end of the processor housing. The sensor provides an integrated measure of deployment depth with Argonaut-ADV velocity data. Details: §6-7.
- **Battery power –** The autonomous and splash-proof systems include battery power for autonomous deployments or as a backup in case of shore-power failure. Details: §6-1 for input power requirements; Section 8 for autonomous operation; §5-7 for battery access.

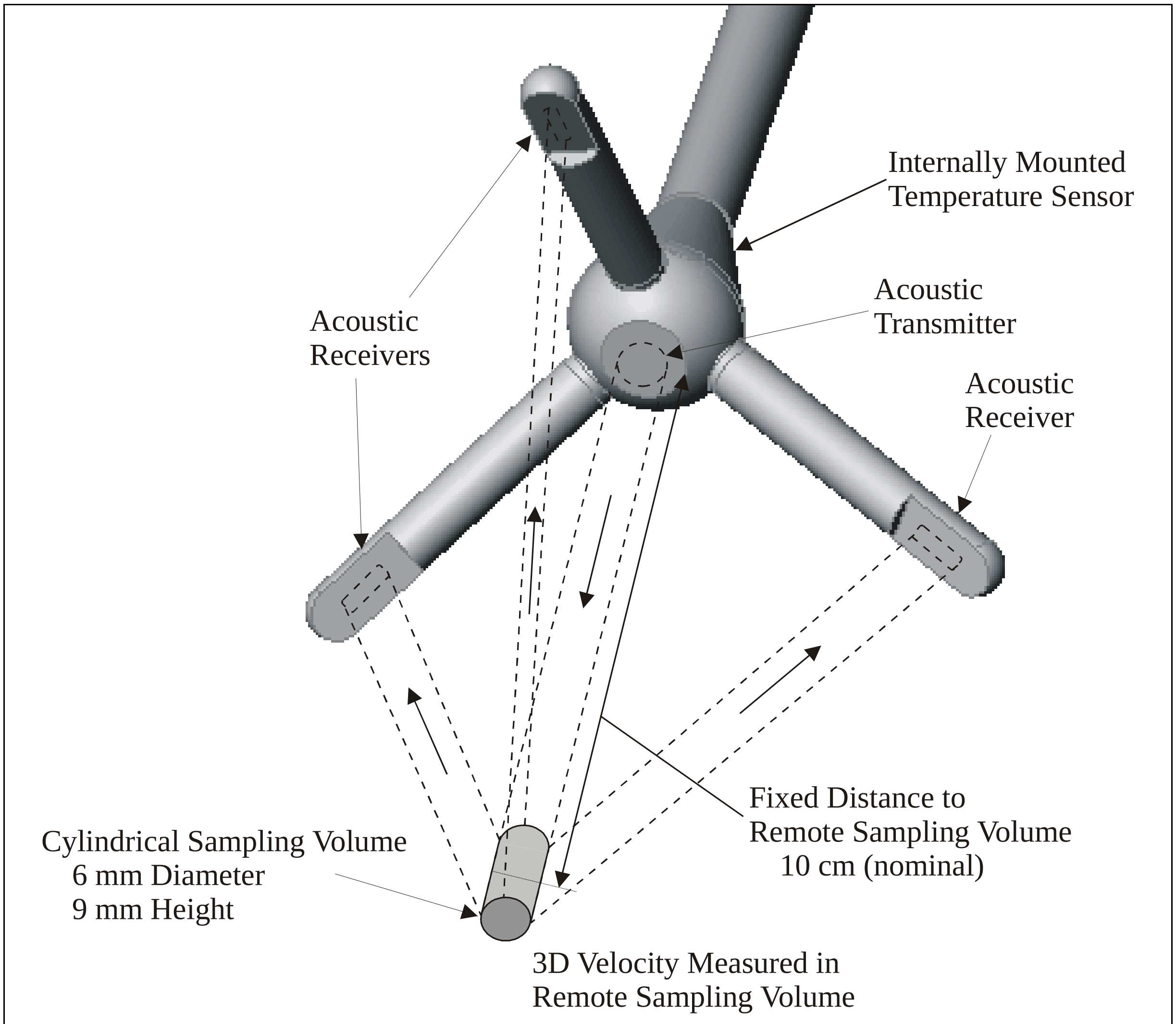

Figure 3 – Argonaut-ADV Probe and Sampling Volume

The following terms are commonly used with respect to the Argonaut-ADV probe (Figure 3).

- **Transmitter –** The central acoustic transmitter generates a short pulse of sound with the majority of energy concentrated in a narrow beam (6 mm in diameter).
- **Receivers –** The acoustic receivers are mounted on arms from the central probe head. The receivers are sensitive to a narrow beam, and are focused on a common volume located a fixed distance from the probe head (nominally 10 cm).
- **Sampling volume –** The sampling volume is the physical location where the Argonaut-ADV makes 2D/3D velocity measurements. Details: *Argonaut-ADV Principles of Operation*.

1-2. Definitions and Terminology

This section defines terms commonly used when working with the Argonaut-ADV.

- **Direct-command interface –** Direct serial communication with the Argonaut-ADV to control system operation and retrieve data.
- **BREAK –** A serial communication signal that causes a hardware reset and returns the Argonaut-ADV to command mode. A **BREAK** consists of holding the transmit line high for at least 300 ms, and is a standard function in most terminal emulator programs.
- **Temperature –** Water temperature (in °C). A default value is entered by the user, and another value is measured using an internal temperature sensor. Temperature is used for sound speed calculations.
- **Salinity –** Water salinity (in ppt). A user-supplied value is used for sound speed calculations.
- **Sound speed –** Speed of sound in water (in m/s). This is used to convert the Doppler shift to velocity. Sound speed is calculated either from user-specified temperature and salinity, or from measured temperature and user-input salinity (§3-8). See the *Argonaut-ADV Principles of Operation* regarding the effect of sound speed on velocity data.

1-3. Sampling Strategies

There are several terms specific to Argonaut-ADV sampling strategies, as shown in Figure 4.

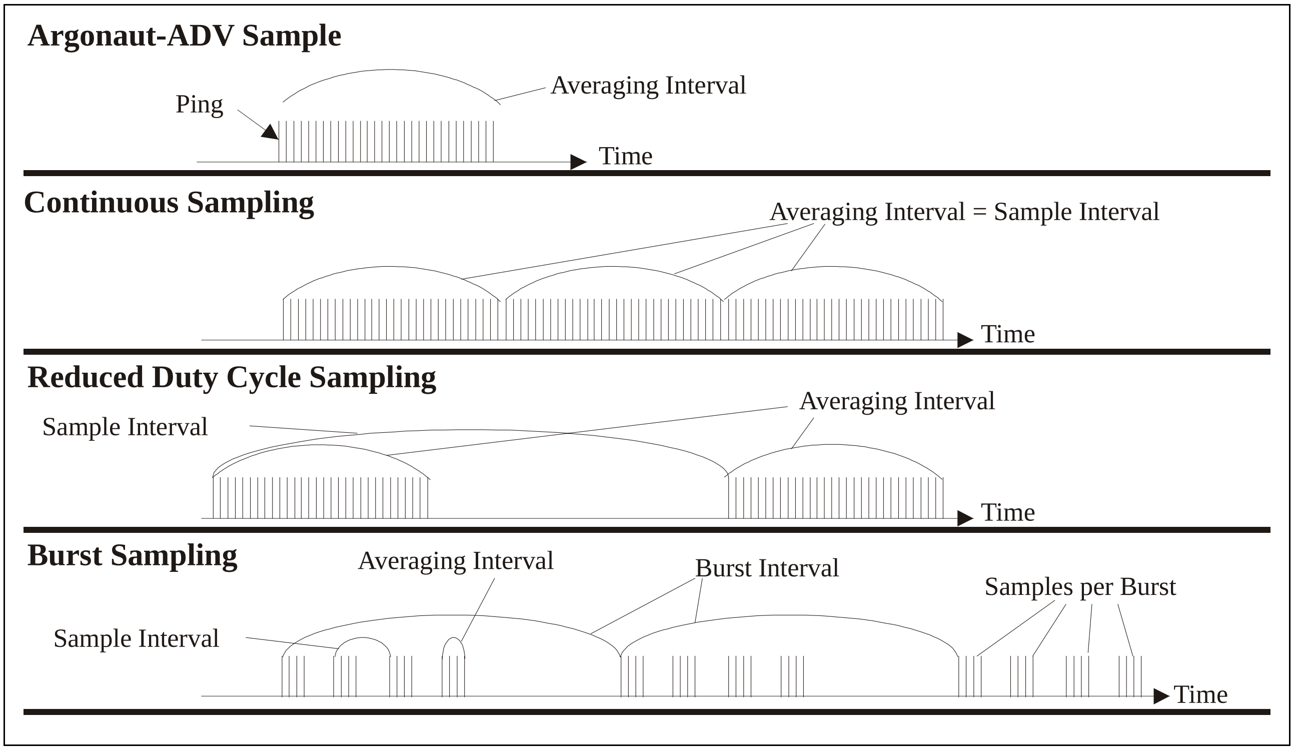

Figure 4 – Argonaut-ADV Sampling Strategies

- **Ping –** A single estimate of the 2D or 3D water velocity.
- **Pinging rate –** The number of pings per second (Hz). The Argonaut-ADV pings at 10 Hz. For specialized applications, the pinging rate can be increased; contact SonTek for details.
- **Sample –** A sample refers to the mean of a number of pings to produce an estimate of 2D or 3D water velocity. A sample includes velocity, standard deviation, signal strength, and sensor data (temperature, pressure, compass).
- **Averaging interval –** The period of time, in seconds, over which the Argonaut-ADV averages data before computing a sample.
- **Sample time –** The Argonaut-ADV records date and time from its internal clock with each sample. The recorded time represents the start of the averaging interval.
- **Sample interval –** The time between sequential samples, in seconds. This is defined as the time from the start of one sample to the start of the next sample, and must be greater than or equal to the averaging interval (or the averaging interval will take precedence).
- **Burst sampling –** Allows you to record a number of samples in rapid succession, and then place the Argonaut-ADV in a low-power state for an extended period. Burst sampling obtains information about both the short- and long-term variation of water velocity without the power and memory required for continuous sampling.

- **Burst interval –** The period of time, in seconds, between each sampling burst. This is measured from the start of one burst to the start of the next burst, and must be greater than the total time required for each burst.
- **Samples per burst –** The number of samples recorded during each burst.

The Argonaut-ADV supports three basic sampling strategies.

- **Continuous sampling –** This is used for real-time data collection or for autonomous deployments that do not have power or data limitations. The sample interval is the same as the averaging interval, and burst sampling is disabled. The system is collecting data at all times.
- **Reduced duty-cycle sampling –** This occurs when the sample interval is greater than the averaging interval. When not collecting data, the Argonaut-ADV enters a low-power state (<1 mW). Duty cycle is calculated as the ratio of the averaging interval to the sample interval. For example, an averaging interval of one minute with a sample interval of five minutes gives a 20% duty cycle and extends battery life by a factor of five.
- **Burst sampling –** This lets you to obtain information about short-term flow variation without requiring continuous operation. The Argonaut-ADV collects a number of samples in rapid succession, and then enters the sleep mode. Duty cycle is calculated as follows.

```
Duty cycle = (Samples_per_burst * Averaging_interval) / Burst_interval
```

See Section 8 for details about system power consumption, calculating battery life, and initiating autonomous deployments.

Section 2. Getting Started

This section contains basic instructions for using the Argonaut-ADV in the most common configurations. These instructions are not intended to be comprehensive, but should be sufficient to learn about the instrument and start collecting data.

Initial testing is best done in a small tank of water where velocities can be introduced by stirring the water. (A flume is a great option if available). Testing can also be done in air without any damage to the system, but no meaningful velocity data will be collected. If testing in water, be sure there is sufficient scattering material for good operation (§6-10).

2-1. Input Power and Battery Operation

The Argonaut-ADV can be run from three different types of power sources.

- SonTek-supplied DC power supply
- SonTek-supplied internal Argonaut-ADV batteries
- User-supplied external power (battery or other)

SonTek DC Power Supply

- All Argonaut-ADV systems include a DC power supply. Different power supplies are used depending on system requirements.
- Cables are configured to match the power supply included with the system.
- If the system includes internal batteries, the system is set up to use the external DC supply instead of the batteries when the DC supply is present.
- To use, simply connect the power/communications cable into the Argonaut-ADV, and then plug the power supply into the wall.

SonTek Internal Batteries

- Battery capacity and expected battery life are described in §8-2.1.
- Battery packs for different system configurations are described in §5-7.
- Batteries for autonomous systems are always connected to the instrument. To use the system from battery power, just connect the power/communication cable and send a **`BREAK`** (within *SonTerm*) or run any of the Argonaut-ADV software programs.
- The splash-proof system with internal battery has a switch on the front panel that must be turned on before the system can be used (an indicator on the front panel will light up).
- All systems include an external DC power supply. If this supply is connected, it will be used instead of the internal batteries. The DC supply is recommended for system testing to conserve battery power.

User-Supplied Power

- The Argonaut-ADV offers several different input power configurations for optimal performance in a variety of applications.
- See §6-1 for a description of input power requirements.
- See §5-5 for system wiring diagrams.

To Avoid Draining the Batteries When System is Not in Use

- Always power the system off before storing the system to prevent draining the batteries.
- The splash-proof configuration can be powered off using the switch on the front panel.
- All Argonaut-ADV configurations can be powered off by establishing direct communications using *SonTerm* and sending the command **`PowerOff`** (§3-7).

2-2. System Diagnostics Using *ArgCheck*

ArgCheck lets you quickly verify all aspects of Argonaut-ADV operation. Learning to use this program, and using it on a regular basis, is the **best way to ensure consistently good data**. The instructions here are not intended to be comprehensive; see the *Argonaut-ADV Software Manual* for details.

1. Mount the probe in a tank of water such that a tank bottom or wall is 20 to 30 cm (8 to 12 in) from the tip of the probe.
2. Add a small amount of the seeding material provided to ensure sufficient scattering material (see the *Argonaut-ADV Principles of Operation*).
3. Connect the Argonaut-ADV power and communication cable(s) from the instrument to COM1 of the controlling computer and to the external power supply included with the system.
4. Start *ViewArgonaut* using **Start | Programs | SonTek Software | ViewArgonaut**.
5. Click **ArgCheck** on the *ViewArgonaut* main menu.
6. The screen display will update every few seconds (watch the time icon in the corner). Look at the on-screen display to verify the following.
   - The water has sufficient scattering material.
   - All receivers see similar signal profiles – same height and location.
   - The boundary reflection is present; move the probe to see the boundary return move.
   - The electronic noise level is reasonable.
7. Click **Exit** to return to the *ViewArgonaut* main menu.

2-3. Real-Time Data Collection with SonTek Software

This software is described in detail in the *Argonaut-ADV Software Manual*. Basic instructions are given below.

1. Mount the probe in a small tank of water.
2. Add a small amount of the seeding material provided to ensure sufficient scattering material (see the *Argonaut-ADV Principles of Operation*).
3. Connect the Argonaut-ADV power and communication cable(s) from the instrument to COM1 of the controlling computer and to the external power supply included with the system.
4. Start *ViewArgonaut* using **Start | Programs | SonTek Software | ViewArgonaut**.
5. Click **Realtime** on the *ViewArgonaut* main menu.
6. Set an averaging interval of 10 seconds, specify a recording file name, and press **OK** to send the parameters to the system. See Section 3 and the *Argonaut-ADV Software Manual* for details about parameter settings.
7. Click on the green **Play** symbol "➤" to start data output and display.
8. Click on the red **Record** symbol "●" to start recording. Make note of the file name.
9. Allow the Argonaut-ADV to collect several minutes of data. Stir the tank as necessary to introduce a reasonable velocity signal.
10. Stop data collection by clicking on the black **Stop** symbol "■".
11. Exit the real-time data collection software and use the postprocessing software to look at the data collected (§2-4).

2-4. Viewing Argonaut-ADV Data (PostProcessing)

ViewArgonaut includes a post-processing utility to display and analyze Argonaut-ADV data.

1. Start *ViewArgonaut* using **Start | Programs | SonTek Software | ViewArgonaut**.
2. Click **PostProcessing** on the *ViewArgonaut* main menu.
3. Use **File | Open** to select a data file to load.
4. Select a file recorded with the real time software (or use the demonstration file included with the software) and click **OK** to load the data.
5. Click **OK** when the software shows a summary of the data file.
6. The software will now show a time-series plot of all velocity data in the file. Try using the following features. See the *Argonaut-ADV Software Manual* for more options.
   - Change the velocity scale by double-clicking on the vertical axis.
   - Change the time display by selecting **View | X-Axis Display as**.
   - Zoom in and out of portions of the data using the zoom in and out icons.
   - Experiment with other icons and menus to see the processing options.
7. Exit the postprocessing software by selecting **File | Exit**.

2-5. Real-Time Data Collection using Serial Output Data

The Argonaut-ADV is often integrated with a variety of data loggers using the direct-command interface and serial output data. For this type of application, it will be helpful to gain experience with the system using the direct-command interface. For a detailed description of all commands, see Section 3. For more information on using the *SonTerm* terminal emulator, see the *Argonaut-ADV Software Manual*.

1. Connect the Argonaut-ADV power and communication cable(s) from the instrument to COM1 of the controlling computer and to the power supply included with the system.
2. Start *SonUtils* using **Start | Programs | SonTek Software | SonUtils**.
3. Click **SonTermW** on the *SonUtils* main menu.
4. The blue (top) portion of the screen shows output from the Argonaut-ADV; the white (bottom) portion shows commands sent by the user.
5. Capture all communication to a text file by selecting **File | Log File**.
6. Click the **`BREAK`** symbol (or press Alt+B) to bring the system into command mode (the Argonaut-ADV command prompt is ">").
7. Type **`help`** and press <Enter> at the command prompt to show menus of the available commands.
8. Use the four "Show" commands (**Show Conf**, **Show System**, **Show Setup**, **Show Deploy**) to display all Argonaut-ADV parameter settings.
9. Type **`Compass CONT`** to display data from the internal compass/tilt sensor (if installed). Rotate and tilt the Argonaut-ADV to verify compass operation (§4-1). Press any key to stop data output.
10. Type **`Sensor CONT`** to display data from the temperature, pressure, and battery voltage sensors (§3-11 and §6-7). Press any key to stop data output.
11. Type **`dir`** and press <Enter> to view the contents of the internal recorder.
12. Select reasonable operating parameters for trial data collection. A sample set of commands is below; see Section 3 for details.
```
VelRange 5 <CR>
AvgInterval 10 <CR>
SampleInterval 10 >CR>
DataFormat LONG <CR>
OutFormat ASCII <CR>
```
13. Begin data collection with the **`Start`** command.
14. Allow the Argonaut-ADV to output a number of samples, and then exit *SonTermW* (**File | Exit**). Now review the output data in the log file specified in Step 5. See §3-15.2 for output data format.

2-6. Autonomous Deployment

Autonomous deployments (i.e., “stand-alone”) use the internal recorder for data storage (and typically operate on battery power). Section 8 contains detailed instructions for autonomous deployments. This section provides a brief overview of the steps used to collect a sample deployment from external power. It assumes you already have a basic familiarity with the direct-command interface.

1. Connect the Argonaut-ADV communication cable from the instrument to COM1 of the controlling computer.
2. Connect the Argonaut-ADV to the battery supply to be used during deployment.
3. Start *SonUtils* using **Start | Programs | SonTek Software | SonUtils**.
4. Click **SonTermW** on the *SonUtils* main menu.
5. Capture all communication to a text file by selecting **File | Log File**.
6. Click the **BREAK** symbol (or press Alt+B) to bring the system into command mode.
7. Select reasonable operating parameters for trial data collection. A sample set of commands is below; see Section 3 for details.
```
VelRange 5 <CR>
AvgInterval 10 <CR>
SampleInterval 10 >CR>
BurstMode NO <CR>
DataFormat LONG <CR>
OutFormat ASCII <CR>
Deployment TEST <CR>
```
8. Begin data collection using the **Deploy** command (this ensures that data is written to the internal recorder).
9. Allow the Argonaut-ADV to collect several minutes of data.
10. Click the **BREAK** symbol (or press Alt+B) to bring the system into command mode.
11. Type **dir** and press <Enter> to view the contents of the internal recorder. You should see a file named **TEST001**.
12. Exit *SonTermW* (**File | Exit**).
13. From the *SonUtils* main menu, click **SonRecW**.
14. Click **Connect** to establish communication with the Argonaut-ADV and list the contents of the recorder.
15. Select the file to be retrieved, and then click **Download** to transfer the data to the computer hard disk.
16. Exit *SonRecW* (**File | Exit**).
17. Look at the data recorded on the recorder using the postprocessing software in ViewArgonaut as described in §2-4.

Section 3. Direct-Command Interface

Before starting data collection, you must set several operational parameters. You can do this using the direct-command interface or the Argonaut-ADV software. This section describes the direct-command interface using a terminal emulator (such as *SonTerm* or *SonTermW*).

- Section 3-1 describes communication protocols and settings.
- Section 3-2 provides an overview of the operational modes of the Argonaut-ADV.
- Section 3-3 gives an important notice about cycling the Argonaut-ADV power source.
- Section 3-4 presents the syntax rules for the direct-command interface.
- Section 3-5 gives a summary of all available commands.
- Sections 3-6 through 3-14 describe each command in detail.
- Section 3-15 describes the data output format.

3-1. Serial Communication Protocols and Settings

The Argonaut-ADV can communicate using several serial communication protocols (see §6-5 for additional information).

- RS232 – Single system operation with cable lengths to 100 meters (300 feet)
- RS422 – Single system operation with cable lengths to 1500 meters (4500 feet)
- RS485 – Multi-system operation with cable lengths to 1500 meters (4500 feet)
- SDI-12 – Single system operation with cable lengths to 100 meters (300 feet)

The protocol is set at the factory based on user requirements. The different protocols have the following effects on the direct-command interface.

- RS232 – Direct-command interface is described here in Section 3.
- RS422 – Direct-command interface is described here in Section 3.
- RS485 – RS485 is normally used only with SonTek-supplied software. The modified interface with system addressing is not described here. See Appendix B for details on RS485 operation.
- SDI-12 – This protocol uses a reduced direct-command interface, which is typically used in conjunction with RS232 for complete programming capabilities. See Appendix C for details on SDI-12 operation.

The default communication settings for all communication protocols are below.

- 9600 baud (§5-4 explains how to change baud rate settings)
- 8 data bits (fixed)
- No parity (fixed)
- 2 stop bits (fixed)

3-2. Modes of Operation

The Argonaut-ADV has five operational modes, each of which is described in this section:

- Command mode
- Data acquisition mode
- Deployment mode
- Sample mode (used with SDI-12)
- Sleep mode

3-2.1. Command Mode

- The Argonaut-ADV can send and receive commands related to all aspects of instrument operation.
- You can enter the command mode from any other mode by sending a **`BREAK`** (§3-4).
- You can enter the command mode from the data acquisition mode using the run-time command "**`+++`**".
- You can put the Argonaut-ADV into any other mode only from the command mode.
- To enter the data acquisition mode from the command mode, use the command **`Start`**.
- To enter the deployment mode from the command mode, use the command **`Deploy`**.
- To enter the sample mode from the command mode, use the command **`Sample`**.
- To enter the sleep mode from the command mode, use the command **`PowerOff`**.
- If the Argonaut-ADV is left idle in the command mode for more than five minutes, it will enter the sleep mode to conserve power.

3-2.2. Data Acquisition Mode

- Data acquisition mode is used for real-time data collection, typically connected to an external power supply and computer or data logger.
- Data acquisition mode is entered from command mode with the command **`Start`**. After the **`Start`** command, the Argonaut-ADV takes a few seconds to initialize and then begins data collection.
- In data acquisition mode, the Argonaut-ADV ignores the deployment parameters **`StartDate`**, **`StartTime`**, and all burst-sampling parameters.
- If the internal recorder has been enabled (**`Recorder ON`**), data are output both over the serial port and to the internal recorder.
- If the recorder has been disabled (**`Recorder OFF`**), data are sent only to the serial port.
- You can exit the data acquisition mode and return to the command mode by sending a **`BREAK`** (§3-4) or by using the run-time command "**`+++`**".
- While in data acquisition mode, the Argonaut-ADV can enter a low-power state between samples. This state is similar to, although not the same as, the sleep mode. The Argonaut-ADV will enter the low-power state if the system command **`AutoSleep`** is set to **`ON`** (the default setting). See §3-7 regarding the **`AutoSleep`** command and §3-14 regarding the effects of the power saving state on the run-time commands.

3-2.3. Deployment Mode

- Deployment mode is used for autonomous data collection (internal recording, typically with battery power).
- Deployment mode is entered from command mode using the command **`Deploy`**.
- In deployment mode, the instrument starts data collection at the date and time specified by **`StartDate`** and **`StartTime`**. If the current date and time are after the specified start date and time, the system begins data collection immediately.
- In deployment mode, data are always stored to the internal recorder regardless of the **`Recorder ON/OFF`** parameter.
- In deployment mode, the Argonaut-ADV will always enter the low-power state between samples regardless of the **`AutoSleep`** parameter (**`AutoSleep`** is forced **`ON`**).
- You can exit the deployment mode and enter the command mode by sending a **`BREAK`**.

3-2.4. Sample Mode

- Sample mode is used with SDI-12 communication protocol to match data-logger requirements.
- Sample mode is entered from command mode using the command **`Sample`**.
- In sample mode, the Argonaut-ADV first performs all setup requirements for data collection. It then enters a low-power mode, awaiting commands from an external data logger.
- In sample mode, the Argonaut-ADV collects one sample at a time on command from an external data logger.
- For more information, see Appendix C.

3-2.5. Sleep Mode

- Sleep mode is used to conserve power when the Argonaut-ADV is not in use. In the sleep mode, the Argonaut-ADV consumes less than 1 mW of power.
- The sleep mode is entered from the command mode using the command **`PowerOff`**.
- You can exit the sleep mode and enter command mode by sending a **`BREAK`** or by sending the command "**`+++`**" (§3-14).
- When in sleep mode, the Argonaut-ADV will not respond to any other external commands. The exception is if system power is switched off and on (§3-3).
- If the Argonaut-ADV is left idle in command mode for more than five minutes, it will enter the sleep mode to conserve power.

To Avoid Draining the Batteries When the System is Not in Use

- Always power the system off before storing the system to prevent draining the batteries.
- The splash-proof configuration can be powered off using the switch on the front panel.
- All Argonaut-ADV configurations can be powered off by establishing direct communications using *SonTerm* and sending the command **`PowerOff`** (§3-7).

3-3. Special Notice when Changing Power Sources

When power to the Argonaut-ADV is turned off and on (e.g., when changing batteries or switching power supplies), the Argonaut-ADV enters the mode it was in before power was lost.

- If previously in command or sleep mode, the system will enter command mode.
- If previously in data acquisition mode, the system will immediately start real-time data collection.
- If previously in deployment mode, the system will start a new deployment. **`StartDate`** and **`StartTime`** are ignored and the new deployment begins immediately. This is a safety feature to avoid data loss in the unlikely event of a problem with the system clock.
- If previously in sample mode, the system will again enter sample mode and wait for a command to begin a new sample.

To Avoid Draining the Batteries When the System is Not in Use

- Always power the system off before storing the system to prevent draining the batteries.
- The splash-proof configuration can be powered off using the switch on the front panel.
- All Argonaut-ADV configurations can be powered off by establishing direct communications using *SonTerm* and sending the command **`PowerOff`** (§3-7).

IMPORTANT:

- When some computers and data loggers are turned on or off, they send a signal out the serial port that can be interpreted by the Argonaut-ADV as a **`BREAK`** (§3-4).
- If the Argonaut-ADV is connected to the serial port, this can interrupt data collection or bring the Argonaut-ADV out of sleep mode and cause the loss of data or the draining of the batteries.
- Always disconnect the Argonaut-ADV from the computer or data logger **before** turning the computer on or off.

3-4. Command Syntax

Definition of **BREAK**:

- The **BREAK** is a serial communication signal that causes a hardware reset and places the instrument in command mode. A **BREAK** consists of holding the data input line high for a period of at least 300 milliseconds. Most terminal emulators include the ability to send a **BREAK**; *SonTerm* (supplied with the Argonaut-ADV) uses Alt+B.

These are the basic rules for direct communication with the Argonaut-ADV.

1. The Argonaut-ADV can be brought into the command mode from any other mode by sending a **BREAK**.
2. All commands consist of a single keyword that may be followed by one or more ASCII parameters.
3. The commands and parameters are <u>not</u> case sensitive.
4. When the Argonaut-ADV has completed a command and is ready to accept another command, it will send the prompt character "**>**".
5. Parameters may be numeric (either integer or floating point), alphanumeric, or a combination (e.g., a date or time string).
6. Commands must be terminated by a carriage return – <CR>.
7. The Argonaut-ADV echoes every character as it is received (except for run-time commands received during data collection – see Section 3-14).
8. After receiving the <CR> that signals the end of the command string, the Argonaut-ADV echoes with an additional line feed character – <LF>.
9. If the Argonaut-ADV recognizes a command as valid it will transmit: <LF>**OK**<CR><LF>.
10. If a command is not recognized, the parameters are out of range, or if the command cannot be executed in the present state, the Argonaut-ADV returns an error message followed by <CR><LF>.

IMPORTANT:

- When some computers and data loggers are turned on or off, they send a signal out the serial port that can be interpreted by the Argonaut-ADV as a **BREAK**.
- If the Argonaut-ADV is connected to the serial port, this can interrupt data collection or bring the Argonaut-ADV out of sleep mode and cause the loss of data or the draining of the batteries.
- Always disconnect the Argonaut-ADV from the computer or data logger **<u>before</u>** turning the computer on or off.

3-5. Direct-Command Summary

The tables below summarize all direct commands that can be used with the Argonaut-ADV, including any abbreviations (i.e., short versions of the same command). These commands are categorized and explained in different sections and tables based on their function.

- Help commands (§3-6)
- System commands (§3-7)
- Setup commands (§3-8)
- Deployment commands (§3-9)
- Recorder commands (§3-10)
- Sensor commands (§3-11)
- Compass commands (§3-12)
- Show commands (§3-13)
- Run-time commands (§3-14)
- CTD commands (§9-1)
- YSI commands (§9-2)

The following abbreviations are used for input parameters to the Argonaut-ADV.

- d Integer input (e.g., 30)
- d.d Decimal real number input (e.g., 0.33 or 1.5)
- yy/mm/dd Date as year, month, and day (e.g., 1996/05/20 or 96/05/20)
- hh:mm:ss 24-hour clock with hour, minute, and second (e.g., 18:15:00)

Help Commands (Section 3-6)

Command	**Short**	**Function**
Help	H or ?	Available help categories
Help System	H/? System	General system commands
Help Setup	H/? Setup	Real-time data collection commands
Help Deploy	H/? Deploy	Autonomous deployment commands
Help Recorder	H/? Recorder	Data recorder commands
Help Sensor	H/? Sensor	Peripheral sensor commands
Help Compass	H/? Compass	Compass/tilt sensor commands
Help Show	H/? Show	Commands to display system configuration

System Commands (Section 3-7)

Command	Short	Function	Parameters
Start	(none)	Starts real-time data collection (enter data acquisition mode)	
Deploy	(none)	Starts autonomous deployment (enter deployment mode)	
SaveSetup	(none)	Save current parameters to EEPROM	
Defaults	DEF	Sets all parameters to factory defaults	
Ver	(none)	Shows CPU firmware version	
DSPVer	(none)	Shows DSP firmware version	
BoardRev	(none)	Shows electronics board revision number	
SerNum	(none)	Shows Argonaut-ADV serial number	
Date <date>	(none)	Shows / sets system clock date	yy/mm/dd
Time <time>	(none)	Shows / sets system clock time	hh:mm:ss
PowerOff	(none)	Puts Argonaut-ADV in sleep mode	
AutoSleep <mode>	AS	If ON, Argonaut-ADV enters reduced power state between samples	ON or OFF
OutMode <mode>	OM	Selects data output mode	AUTO or POLLED
OutFormat <format>	OF	Specifies output data format	ASCII, BINARY, SEABIRD, METRIC, or ENGLISH
Recorder <status>	(none)	Turns internal recording on or off	ON or OFF
RecMode <mode>	(none)	Sets recording mode	NORMAL

Setup Commands (Section 3-8)

Command	Short	Function	Parameters
Temp <temperature>	(none)	Set default temperature (°C)	d.d
Sal <salinity>	(none)	Set default salinity (ppt.)	d.d
AvgInterval <seconds>	AI	Set averaging interval (sec)	d
SampleInterval <seconds>	SI	Set time between samples (sec)	d
VelRange <range>	VR	Sets velocity range (index value)	d [0 to 5]
CoordSystem <system>	CY	Set coordinate system for velocities	BEAM, XYZ or ENU
TempMode <mode>	TM	Set temperature used for sound speed calculations	USER or MEASURED
DataFormat <format>	DF	Set output and stored data format	LONG or SHORT

Deployment Commands (Section 3-9)

Command	Short	Function	Parameters
Deployment <name>	(none)	Set deployment name (5 characters max)	ASCII text
Comments	(none)	Enter deployment comments	ASCII text
StartDate <date>	SD	Set deployment start date	yy/mm/dd
StartTime <time>	ST	Set deployment start time	hh:mm:ss
AvgInterval <seconds>	AI	Set averaging interval (sec)	d
SampleInterval <seconds>	SI	Set time between samples (sec)	d
BurstMode <mode>	BM	Enable or disable burst sampling	YES or NO
BurstInterval <seconds>	BI	Set time between bursts (sec)	d
SamplesPerBurst <number>	SB	Set number of samples per burst	d

Recorder Commands (Section 3-10)

Command	Short	Function	Parameters
LD or Dir	(none)	List deployments currently on recorder	
Format	(none)	Erase all data from recorder	
RecStatus	(none)	Show recorder size and free space left	
Recorder <status>	(none)	Turns internal recording on or off	ON or OFF
RecMode <mode>	(none)	Sets recording mode (**BUFFER MODE IS NOT CURRENTLY ENABLED**)	NORMAL or BUFFER
OD <name>	(none)	Open deployment to access data	<deployment name>
CD	(none)	Return name of currently open deployment	
RC	(none)	Retrieve configuration information from currently open deployment	
RSA [N]	(none)	Retrieve next N samples from file, ASCII format	d
RSB [N]	(none)	Retrieve next N sample from file, binary format	d
FS	(none)	Go to first sample in deployment	
LS	(none)	Go to last sample in deployment	
GS <sample number>	(none)	Go to <sample number> in deployment	d
CS	(none)	Return current sample number	
NS	(none)	Return number of samples in deployment	

Sensor Commands (Section 3-11)

Command	Short	Function	Parameters
Sensor	(none)	Display most recent temperature, pressure, and battery voltage data	
Sensor CONT	(none)	Display continuous temperature, pressure, and battery voltage data	
PressOffset	(none)	Display pressure sensor calibration offset	
PressScale	(none)	Display pressure sensor calibration 1st order coefficient	
PressScale_2	(none)	Display pressure sensor calibration 2nd order coefficient	

Compass Commands (Section 3-12)

Command	Short	Function	Parameters
Compass	(none)	Display most recent heading, pitch, and roll data	
Compass CONT	(none)	Display continuous heading, pitch, and roll data	
Compass CAL	(none)	Perform a compass calibration	

Show Commands (Section 3-13)

Command	Short	Function
Show Conf	S Conf	Display hardware configuration parameters
Show System	S System	Display general system parameters
Show Setup	S Setup	Display real time data collection parameters
Show Deploy	S Deploy	Display autonomous deployment parameters

Run-Time Commands (Section 3-14)

Command*	Short	Function
+++	(none)	Return to command mode (stop data collection)
O	(none)	Transmit last sample
T	(none)	Transmit Argonaut-ADV date and time
C+	(none)	Adjust real-time clock +1 second
C-	(none)	Adjust real-time clock -1 second
A	(none)	Transmit time left in current averaging interval (seconds)

*These commands available only in data acquisition mode.

CTD Commands (Section 9-1)

Command	Shortcut	Function	
CTD	(none)	Display most recent CTD reading	
CTD CONT	(none)	Display continuous CTD readings	
CTD Talk	(none)	Direct serial communication with CTD	

YSI Commands (Section 9-2)

Command	Shortcut	Function	
YSI	(none)	Display most recent YSI reading	
YSI CONT	(none)	Display continuous YSI readings	
YSI Talk	(none)	Direct serial communication with YSI	

3-6. Help Commands

The Argonaut-ADV direct-command interface contains several on-line help commands. These are designed such that, by starting with "Help", you are led through a series of menus that show all Argonaut-ADV commands. The following help commands display all commands you would normally use for any aspect of Argonaut-ADV operation. Entering any of these commands at the direct-command prompt will display the appropriate help menus.

- **`Help`** – Lists all available help menus
- **`Help System`** – General system commands (§3-7)
- **`Help Setup`** – Real-time data collection commands (§3-8)
- **`Help Deploy`** – Autonomous deployment commands (§3-9)
- **`Help Recorder`** – Data recorder commands (§3-10)
- **`Help Sensor`** – Peripheral sensor commands (§3-11)
- **`Help Compass`** – Compass/tilt sensor commands (§3-12)
- **`Help Show`** – Commands to display system configuration (§3-13)

3-7. System Commands

System commands relate to general operation of the Argonaut.

- Starting data collection
- Displaying the serial number
- Setting the clock
- Data output and storage

Each command is shown with its full name, short name (if one exists), optional parameters (in brackets), and appropriate detailed information.

`Start`

- This command starts real-time data collection, putting the Argonaut-ADV into data acquisition mode (§3-2.2).
- The system first saves all recently entered commands (i.e., does a **`SaveSetup`**).
- Data collection begins immediately (**`StartDate`** and **`StartTime`** are ignored).
- Burst sampling cannot be used (burst sampling parameters are ignored).
- The system enters a low-power state between samples if **`AutoSleep`** is **`ON`**.
- Run-time commands can only be used when **`AutoSleep`** is **`OFF`**.
- Data will be stored to the recorder if enabled (**`Recorder ON`**).

`Deploy`

- This command starts autonomous data collection, putting the Argonaut-ADV into deployment mode (§3-2.3).
- The system first saves all recently entered commands (i.e., does a **`SaveSetup`**).
- Data collection begins when the Argonaut-ADV clock reaches the specified **`StartDate`** and **`StartTime`**. If the current date and time is after the specified start date and time, data collection begins immediately.
- Argonaut-ADV data are stored to the recorder regardless of the **`Recorder`** setting.
- The system enters a low-power state between samples (**`AutoSleep`** is forced **`ON`**).
- Note: Do not confuse the **`Deploy`** and **`Deployment`** commands (§3-9).

`Sample`

- The **`Sample`** command is used with the SDI-12 serial interface.
- See Appendix C for a description of the SDI-12 interface.

`SaveSetup`

- This saves all current parameter settings to internal memory (EEPROM).
- This must be done before the system is shut down (or before a **`BREAK`** is sent) or any recently entered commands will be lost.
- This is performed automatically as part of the **`Start`**, **`Deploy`**, and **`Sample`** commands.

`Defaults` *or* **`DEF`**

- This sets all parameters (except baud rate) to the factory default values. The baud rate remains at the currently active value. To change the baud rate, see Section 5-4.
- See the individual command descriptions for default values.

`Ver`

- This outputs the version number of the CPU firmware.

`DSPVer`

- This outputs the version number of the DSP firmware.

`BoardRev`

- This outputs the revision number of the Argonaut-ADV processing electronics boards.

`SerNum`

- This command returns the instrument serial number from memory (should match the serial number on the Argonaut-ADV probe).

`Date [yy/mm/dd]`

- Without parameter: returns the date from the Argonaut-ADV clock.
- When given a date in the form "yy/mm/dd" where yy = year (2 or 4 digits), mm = month (2 digits), and dd = day (2 digits), it resets the date.
- Example: **`Date 2001/09/08`** or **`Date 01/09/08`** are equivalent commands setting the date to September 8, 2001.

`Time [hh:mm:ss]`

- Without parameter: returns the time from the Argonaut-ADV clock.
- When given a time in the form of "hh:mm:ss" (24-hour clock, where hh = hour (2 digits), mm = minute (2 digits), and ss = seconds (2 digits)), it resets the time.
- Example: **`Time 16:24:08`** sets the time to 16:24:08 (4:24:08 p.m.).

`PowerOff`

- This puts the Argonaut-ADV into sleep mode (§3-2.5).
- We recommend placing the Argonaut-ADV in sleep mode whenever it is not in use.
- The Argonaut-ADV will enter sleep mode if left idle in command mode for more than five minutes.

`AutoSleep` *or* **`AS [ON|OFF]`**

- Default parameter: **`ON`**
- Without parameter: returns its current setting.
- This setting determines whether the Argonaut-ADV enters a reduced power state during data collection.
- When **`ON`**, the Argonaut-ADV will enter the reduced power state between samples. Power consumption is less than 1 mW in the reduced power state.
- When **`OFF`**, the Argonaut-ADV electronics remain active even when not collecting data.
- Must be **`OFF`** to use the Run-Time commands (§3-14).
- In deployment mode, **`AutoSleep`** is forced **`ON`**.

OutMode *or* **OM [AUTO|POLLED]**

- Default parameter: **AUTO**
- Without parameter: returns its current setting.
- This setting determines whether data are sent over the serial port after the completion of a sample (**AUTO**), or only sent when a specific run-time command is received (**POLLED**).
- The run-time command "**O**" (Output) causes the output of the last sample from the buffer to be sent (§3-14).

OutFormat *or* **OF [BINARY|ASCII|SEABIRD|METRIC|ENGLISH]**

- Default parameter: **ASCII**
- Without parameter: returns its current setting.
- This setting determines the format of the data output through the serial port. Section 3-15 has a description of the output data formats (**BINARY**, **ASCII**, **SEABIRD**, **METRIC**, **ENGLISH**).
- Data stored on the internal recorder are always stored in binary format.

Recorder [ON|OFF]

- Default parameter: **ON**
- Without parameter: returns its current setting.
- When **ON**, all data collected by the Argonaut-ADV will be stored on the internal recorder.
- When **OFF**, any data collected in data acquisition mode (via the **Start** command) will not be stored to the recorder.
- When in deployment mode (via the **Deploy** command), data are always stored on the internal recorder.

RecMode [NORMAL|BUFFER]

- This command is not enabled in this version of the firmware.

3-8. Setup Commands

Setup commands affect the primary data collection parameters of the Argonaut-ADV.

- Temperature
- Salinity
- Averaging interval
- Sample interval
- Velocity Range
- Coordinate system
- Data format

Note that the timing commands **`AvgInterval`** and **`SampleInterval`** are also listed under deployment commands (§3-9).

Each command is shown with its full name, short name (if one exists), optional parameters (in brackets), parameter range (if appropriate), and appropriate detailed information.

`Temp [d.d]`

- Default parameter: **`20.0`** (°C)
- Parameter range: **`-5.0`** to **`60.0`** (°C)
- Without parameter: returns its current setting.
- When used with a valid input parameter (-5.0°C to 60.0°C), the user-specified temperature is set to this value.
- This temperature value is used to calculate sound speed if **`TempMode`** is set to **`USER`**.
- See the *Argonaut-ADV Principles of Operation* regarding the effect of sound speed on velocity data.

`Sal [d.d]`

- Default parameter: **`34.5`** (ppt)
- Parameter range: **`0.0`** to **`60.0`** (ppt)
- Without parameter: returns its current setting.
- When used with a valid input parameter (0 ppt to 60 ppt), the salinity is set to this value.
- This salinity value is used to calculate sound speed.
- See the *Argonaut-ADV Principles of Operation* regarding the effect of sound speed on velocity data.

`AvgInterval` *or* **`AI [d]`**

- Default parameter: **`120`** (s)
- Parameter range: **`1`** to **`3600`** (s; maximum is equivalent to 60 minutes)
- Without parameter: returns its current setting.
- When used with a valid integer parameter, the averaging interval is set to this value (in seconds).
- The minimum effective averaging interval is 3 s. Settings less than 3 s, unless using the real-time software, give data output at 3-s intervals. Settings above 3 s give data output at the specified time (or at the **`SampleInterval`**, if higher).

`SampleInterval` *or* **`SI [d]`**

- Default parameter: **`1200`** (s; 20 minutes)
- Parameter range: **`1`** to **`43200`** (s; maximum is equivalent to 12 hours)
- Without parameter: returns its current setting.
- When used with a valid integer parameter, the sample interval is set to this value (in seconds).
- Sample interval is the time between the start of successive samples (§1-3).
- If **`AvgInterval`** > **`SampleInterval`**, then **`AvgInterval`** will take precedence.

`VelRange` *or* **`VR [d]`**

- Default parameter: **`5`** (Automatic velocity range; see table below)
- Parameter range: **`0`** to **`5`** (see table below for velocity range value)
- Without parameter: returns its current setting.
- When used with an integer parameter from 0 to 5, the velocity range is set to this value. The table below shows the maximum velocity range corresponding to each setting.
- Except for severely power-limited applications, we recommend using the automatic velocity range (index value 5).
- If the velocity range is set too low, data may become corrupted and unrecoverable.
- See the *Argonaut-ADV Principles of Operation* for more information about velocity range settings.

VR Index	10-MHz ArgADV Velocity Range
0	±3 cm/s
1	±15 cm/s
2	±50 cm/s
3	±200 cm/s
4	±600 cm/s
5	Automatic (0 to 600 cm/s)

`CoordSystem` *or* **`CY [BEAM|XYZ|ENU]`**

- Default parameter: **`XYZ`**
- Without parameter: returns its current setting.
- When used with an appropriate parameter, it sets the coordinate system to this value.
- **`BEAM`** causes velocity data to be stored and output as along-beam velocities.
- **`XYZ`** causes velocity data to be recorded and output in the Cartesian coordinate system relative to the Argonaut-ADV.
- **`ENU`** causes the Argonaut-ADV to use the compass/tilt sensor (if installed) data to transfer velocity data in Earth (East-North-Up) coordinates.
- See Section 6-4 for coordinate system details.

TempMode *or* **TM [USER|MEASURED]**

- Default parameter: **MEASURED**
- Without parameter: returns its current setting.
- When used with an appropriate parameter, it sets the temperature mode to this value.
- This determines whether the user-input temperature (**USER**), or the value from the temperature sensor (**MEASURED**), is used for sound speed calculations.
- The temperature sensor is specified as accurate to ±0.1°C. We recommend using **MEASURED** unless there is reason to suspect the temperature sensor has been damaged.
- See the *Argonaut-ADV Principles of Operation* regarding the effect of sound speed on velocity data.

DataFormat *or* **DF [LONG|SHORT]**

- Default parameter: **LONG**
- Without parameter: returns its current setting.
- When used with an appropriate parameter, it sets the data format to this value.
- This determines the format of data output over the serial port and to the internal recorder. **LONG** format includes all available diagnostic data and requires 36-76 bytes of data storage per sample (binary format). **SHORT** includes only minimal diagnostic data and requires 20-60 bytes of storage per sample (binary format). **SHORT** is intended only for autonomous deployments with large data storage requirements.
- See Sections 3-15 and 8-2 regarding the calculation of data storage requirements.

3-9. Deployment Commands

Deployment commands affect the parameters used for autonomous deployments.

- Deployment name
- Averaging interval
- Sample interval
- Start date and time
- Burst sampling parameters.

Note that two of the timing commands (averaging interval and sample interval) are also listed under Setup Commands (§3-8).

Each command is shown with its full name, short name (if one exists), optional parameters (in brackets), parameter range (if applicable), and appropriate detailed information.

`Deployment [name]`

- Default parameter: **`DEF`**
- Without parameter: returns its current setting.
- When used with an ASCII string of no more than five characters (letters or digits), the deployment name is set to this value.
- This determines the file name under which data are stored to the internal recorder.
- All data from a single **`Deploy`** or **`Start`** command are stored in one file.
- The file name on the recorder is the deployment name with a 3-digit number indicating the sequence of files under this name. For example, if the deployment name is **`LAKE`**, the data from the first **`Deploy`** or **`Start`** command will be stored in a file named **`LAKE001`**. If data collection is stopped and re-started without changing the deployment name, the numbers will increment; e.g. **`LAKE002`**, **`LAKE003`**, etc.
- Note: Do not confuse the **`Deployment`** and **`Deploy`** commands (§3-7).

`Comments`

- This command lets you enter comments that will be stored in the data file.
- There are three comment lines, each with a maximum of 60 characters.

`StartDate` *or* **`SD [yy/mm/dd]`**

- Default parameter: **`1995/01/01`** (January 1, 1995)
- Without parameter: returns the deployment start date.
- When used with a date in the correct format (see **`Date`** command, §3-7), the starting date for data collection is set. This date is used only in deployment mode (using the **`Deploy`** command).
- If the start date and time are before the current date and time, data collection will begin immediately.

StartTime *or* **ST [hh:mm:ss]**

- Default parameter: **00:00:00**
- Without parameter: returns the deployment start time.
- When used with a time in the correct format (see **Time** command, §3-7), the start time of data collection is set. This time is used only in the deployment mode (using the **Deploy** command).
- If the start date and time are before the current date and time, data collection will begin immediately.

AvgInterval *or* **AI [d]**

- See description under Setup Commands (§3-8).

SampleInterval *or* **SI [d]**

- See description under Setup Commands (§3-8).

BurstMode *or* **BM [NO|YES]**

- Default parameter: **NO**
- Without parameter: returns its current setting.
- Burst sampling can only be used in deployment mode (data collection started with the **Deploy** command). In data collection mode (using the **Start** command), this parameter is ignored. See Section 1-3 for a description of burst sampling.
- **NO** disables burst sampling; **YES** enables burst sampling.

BurstInterval *or* **BI [d]**

- Default parameter: **1200** (s; 20 minutes)
- Parameter range: **1** to **43200** (s; maximum is equivalent to 12 hours)
- Without parameter: returns its current setting.
- When used with a valid integer parameter, the burst interval is set to this value (in seconds). See Section 1-3 for a description of burst sampling.
- This command is ignored unless **BurstMode** is set to **YES**, and data collection is started with the **Deploy** command.

SamplesPerBurst *or* **SB [d]**

- Default parameter: **1**
- Parameter range: **1** to **1000**
- Without parameter: returns its current setting.
- When used with a valid integer parameter, the number of samples per burst is set. See Section 1-3 for a description of burst sampling.
- This command is ignored unless **BurstMode** is set to **YES**, and data collection is started with the **Deploy** command.

3-10. Recorder Commands

Recorder commands allow direct access to data stored in the Argonaut-ADV internal recorder.

- Listing files
- Checking recorder capacity
- Extracting data

Each command is shown with its full name, short name (if one exists), optional parameters (in brackets), and appropriate detailed information. The end of this section gives examples of how recorder commands can be used to access data on the internal recorder.

`Dir` *or* **`LD`**

- Lists a directory of the deployments currently stored on the recorder.

`Format`

- Erases all data from the recorder.
- Naturally, you should take some care before executing this command.
- Upon execution, you are asked to confirm the erasure of all data. The Argonaut-ADV will give an updated display showing its progress in re-formatting the memory card (the process will take a few seconds).

`RecStatus`

- Shows the installed recorder size and the amount of free space remaining.

`Recorder [ON|OFF]`

- See description under System Commands (§3-7).

`RecMode [NORMAL|BUFFER]`

- See description under System Commands (§3-7).

`OD [name]` *(for Open Deployment)*

- When the open deployment command is given an existing file name as its parameter, it allows access to data within that file.
- Upon opening a file, a marker is placed on the first sample in the file. The file marker specifies the next sample to retrieve and is used by other recorder commands.

`CD` *(for Current Deployment)*

- Returns which recorder deployment file is now open.

`RC` *(for Retrieve Configuration)*

- Retrieves configuration information from the currently open file.
- This includes all information in the file header that is stored only once per data file.
- This information is retrieved in a self-explanatory ASCII text format.

RSA [N] (for Retrieve Sample in ASCII)

- Retrieves **N** samples from the current file in ASCII format.
- If **N** is not specified, one sample is retrieved.
- The first sample retrieved will be the one given by the file marker; after executing this command, the file marker is moved to the next sample after those retrieved.
- See Section 3-15 for a description of the output data format.

RSB [N] *(for Retrieve Sample in Binary)*

- Retrieves **N** samples from the current file in binary format.
- If **N** is not specified, one sample is retrieved.
- The first sample retrieved will be the one given by the file marker; after executing this command, the file marker is moved to the next sample after those retrieved.
- See Section 3-15 for a description of the output data format.

FS *(for First Sample)*

- Moves the file marker to the first sample in the file.

LS *(for Last Sample)*

- Moves the file marker to the last sample in the file.

GS [sample number] *(for Go to Sample)*

- Moves the file marker to the sample number specified.
- This sample will be the next retrieved with the **RSA** or **RSB** commands.

CS *(for Current Samples)*

- Returns the number of current samples shown by the file marker.

NS *(for Number of Samples)*

- Returns the number of samples in the currently open file.

The following are examples of how to access recorder data from the direct-command interface. The Argonaut-ADV software includes a program to download data files (see the *Argonaut-ADV Software Manual*) and the direct access commands here are not needed for most applications.

<u>Example 1: Retrieve configuration data from deployment LAKE001.ARG</u>

- **LD** to list deployments
- **OD LAKE001** to open the deployment
- **RC** to retrieve configuration

<u>Example 2: Retrieve the last 5 samples in ASCII format from deployment LAKE001.ARG</u>

- **LD** to list deployments
- **OD LAKE001** to open the deployment
- **NS** to retrieve the number of samples in the file (assume 1355 for this example)
- **GS 1351** to go to sample number 1351 in the file (fifth from the last sample)
- **RSA 5** to retrieve the last five samples in ASCII format

3-11. Sensor Commands

In normal Argonaut-ADV operation, all commands to the sensors are handled automatically, and no direct commands need to be sent. These commands are provided for diagnostic purposes only. See Sections 6-6 and 6-7 for information about the temperature and pressure sensors.

Each command is shown with its full name, short name (if one exists), optional parameters (in brackets), and appropriate detailed information.

`Sensor [CONT]`

- Without parameter: Display once the current temperature (°C), pressure (decibar), and battery voltage (V DC) data.
- With parameter: Display continuously the temperature (°C), pressure (decibar), and battery voltage (V DC) data. Press any key to stop the output of sensor data.

`PressOffset`

- Display the pressure sensor offset value. See Section 6-7 for details on pressure sensor calibration.

`PressScale`

- Display the pressure sensor calibration 1st order coefficient. See Section 6-7 for details on pressure sensor calibration.

`PressScale_2`

- Display the pressure sensor calibration 2nd order coefficient value. See Section 6-7 for details on pressure sensor calibration.

3-12. Compass Commands

In normal operation, all commands to the compass are sent automatically and no direct commands need to be sent. The commands in this section are provided to assist in diagnosing problems and to give greater flexibility in Argonaut-ADV operations. For a detailed description of the optional compass/tilt sensor, see Section 4.

Each command is shown with its full name, short name (if one exists), optional parameters (in brackets), and appropriate detailed information.

`Compass [CONT]`

- Without parameter: Display <u>once</u> the most recent heading, pitch, and roll data from the compass/tilt sensor.
- With parameter: Display <u>continuously</u> the heading, pitch, and roll data from compass/tilt sensor (updated twice per second). Press any key to stop data output and return to command mode.
- Data are output in a self-explanatory, ASCII text format.

`Compass CAL`

- Perform a compass/tilt sensor calibration.
- This is done to account for ambient magnetic fields that will affect compass heading (typically caused by ferrous metals) and should be performed before any deployment.
- The Argonaut-ADV will output instructions for performing the calibration and provide a continuous display of heading, pitch, and roll.
- Press any key to terminate the calibration, view the calibration score, and return to command mode.
- See Section 4-4 for more information about compass calibration and for details on interpreting the calibration score.

3-13. Show Commands

There are four “show” commands to display current Argonaut-ADV parameter settings. Samples of these commands and their outputs are shown below.

Show Conf

- Displays the Argonaut-ADV hardware configuration. See Section 5-1 for information about individual settings.
- Example:

```
>show conf+

HARDWARE CONFIGURATION PARAMETERS
---------------------------------
System Type -------------------- ADV
Sensor serial # ---------------- A263
Sensor frequency – (kHz) ------- 10000
Number of beams ---------------- 3
Beam Geometry ------------------ 3_BEAMS
Slant angle – (deg) ------------ 15.0
Orientation -------------------- DOWN
Compass installed  ------------- NO
Recorder installed ------------- YES
Temperature sensor ------------- YES
Pressure    sensor ------------- NO
Ctd         sensor ------------- NO
PressOffset  – (dbar) ---------- 0.000000
PressScale  -- (dbar/count) ---- 0.000000
PressScale_2 – (pdbar/count^2) – 0
Waves Option ------------------- NO
```

Show System

- Displays the current system parameters.
- Example:

```
>show system

CURRENT SYSTEM PARAMETERS
-------------------------
CPU Ver --- ARG 11.2
DSP Ver --- DSP 1.0
BoardRev -- REV C
Date ------ 2000/10/03
Time ------ 16:02:12
AutoSleep – YES
OutMode --- AUTO
OutFormat – BINARY
Recorder -- ON
RecMode --- NORMAL
```

Show Setup

- Displays the current data collection setup parameters.
- Example:

```
>show setup

CURRENT SETUP PARAMETERS
------------------------
Temp ----------- 20.00 deg C
Sal ------------ 0.00 ppt
TempMode ------- MEASURED
Sound Speed ---- 1481.6 m/s
AvgInterval ---- 120 s
SampleInterval – 1200 s
CoordSystem ---- XYZ
VelRange ------- +/-AUTO (0-600) cm/s
DataFormat ----- LONG
```

Show Deploy

- Displays the current deployment parameters.
- Example:

```
>show deploy

CURRENT DEPLOYMENT PARAMETERS
-----------------------------
Deployment ------ BOUND
StartDate ------- 2000/10/01
StartTime ------- 09:49:51
AvgInterval ----- 10 s
SampleInterval -- 10 s
BurstMode ------- DISABLED
BurstInterval --- 1200 s
SamplesPerBurst – 1
Comments:
Argonaut-ADV Testing
SonTek – We know how fast the water moves.
Do you?
```

3-14. Run-Time Commands

Run-time commands are used during data collection and have been added to simplify integration of the Argonaut-ADV with a variety of data-logging systems.

- **AutoSleep** (§3-7) is normally disabled (**OFF**) to ensure that the Argonaut-ADV will immediately respond to run-time commands.
- If **AutoSleep** is **ON** (to reduce power consumption), or if the system is in deployment mode (which forces **AutoSleep ON**), you will need to send several characters before entering any run-time command to ensure the system is awake (see below).
- Run-time commands are commonly used while using the **POLLED** output mode (see **OutMode** in §3-7). This causes the system to only output a data sample upon request, and not to output data automatically at the end of a sample.

Run-time commands are typically used as follows.

- If **AutoSleep** is **OFF**, run-time commands can be sent at any time.
- If **AutoSleep** is **ON**, the Argonaut-ADV must be alerted by sending a few carriage returns (<CR>; ASCII character code 13) before sending the run-time command.
  - It may be necessary to send more than one <CR> because during some phases of its operation, the Argonaut-ADV serial port is unable to recognize the arrival of a single character.
  - When the Argonaut-ADV recognizes the <CR>, it will respond with a **$** prompt to indicate that for the next 10 seconds it will accept run-time commands.
  - Any <CR> that arrives after the Argonaut-ADV has output the **$** sign is ignored (although it does reset the 10-second countdown).
  - If no additional characters are received within 10 seconds, the Argonaut-ADV will resume regular operation, and the sequence will have to be repeated in order to wake the system up.
  - After the Argonaut-ADV is awake and it outputs the **$** sign, you can use any of the single character run-time commands to communicate with the system.
- If the Argonaut-ADV is in the middle of an averaging interval, it continues pinging. As long as no **BREAK** or "+++" sequence are sent, the system continues working as usual.

The run-time commands described below can be used without causing any delay or interruption of data collection. Argonaut-ADV responses to any of these commands may be delayed up to one second (this is the frequency at which the incoming command buffer is checked); allow for up to a 1-second delay after sending one of these commands.

+++ *(alternative **BREAK** command)*

- Sending three + characters in succession will cause the Argonaut-ADV to terminate data collection and return to the command mode.
- The characters must arrive within a time span of 3 seconds.
- This command is provided as an alternative to sending a **BREAK** when relaying data over a modem (where sending a **BREAK** command may not be possible).
- This command can also be used to wake the Argonaut-ADV from sleep mode. Please note that the system may not recognize the first + character. You may need to send more than three + characters in succession to wake-up the system. All characters must arrive within the span of 3 seconds.

O *(output last sample)*

- Sending an "**O**" (letter "oh"; not zero) to the Argonaut-ADV tells it to output the last data sample collected.
- The last sample is stored internally and is updated at the end of each averaging interval.
- At the end of each averaging interval, the Argonaut-ADV places the sample in an output buffer in the format specified by the **OutFormat** command (**BINARY**, **ASCII**, **SEABIRD**, **METRIC**, **ENGLISH**; see §3-15).
- If the **OutMode** (output mode) command is set to **AUTO**, the Argonaut-ADV immediately transmits the buffer contents through the serial port. If **OutMode** is set to **POLLED**, the Argonaut-ADV continues data collection without transmitting the buffer contents.
- In either output mode (**AUTO** or **POLLED**), the last sample remains in the output buffer until the next sample is completed. At this time, the contents of the buffer will be replaced with the new sample.
- When using the **POLLED** output mode, it is your responsibility to request transmission of the buffer after each sample is collected and before the averaging interval for the next sample is completed.
- The data sample upload can be done as many times as desired without significantly affecting data collection, since the Argonaut-ADV uses only a few milliseconds of processing time to re-transmit the entire data buffer.

T *(output date/time)*

- Sending the character "T" during data collection causes the Argonaut-ADV to output the current date and time from the Argonaut-ADV clock.
- The clock is read immediately before the date/time data are output, which can be up to one second after the **T** command is sent.
- The date/time output will be in **ASCII** or **BINARY** format depending on the current setting of the **OutFormat** parameter. If **OutFormat** is set to **ASCII**, **SEABIRD**, **METRIC**, or **ENGLISH**, time is output in **ASCII** format.
- In ASCII format, the following line will be sent.

```
yyyy/mm/dd hh:mm:ss.hh  <CR><LF>
```

- In **BINARY** format, the following nine bytes will be sent.

Run Time Command "T" Binary Output Record

Field	Offset	Length	Description
Year	0	2	Integer four digit calendar year (i.e., 1995)
Month	2	1	Unsigned character
Day	3	1	Unsigned character
Hour	4	1	Unsigned character
Minute	5	1	Unsigned character
Sec100	6	1	Unsigned character – hundredths of a second
Second	7	1	Unsigned character
CheckSum	8	1	1-byte checksum of preceding eight bytes (§A-4 explains checksum calculation.)

C+ *and* ***C-*** *(clock adust)*

- The **C** command is used to adjust the Argonaut-ADV clock.
- **C+** advances the clock one second.
- **C-** sets the clock back one second.
- After a successful completion of this command, the Argonaut-ADV will output the acknowledgment: **OK** <CR><LF>.

A *(averaging interval time left)*

- Sending the character "A" during data collection causes the Argonaut-ADV to output the time left in the current averaging interval (in seconds).
- The remaining time is output in either **ASCII** or **BINARY** format depending on the setting of the **OutFormat** parameter. If **OutFormat** is set to **ASCII**, **SEABIRD**, **METRIC**, or **ENGLISH**, the time remaining is output in **ASCII** format.
- In **ASCII** format, the following line will be sent, where <*TimeLeft*> is an integer value without leading spaces.

```
<TimeLeft><CR><LF>
```

- In **BINARY** format, the following five bytes will be sent:

Run-Time Command "A" Binary Output Record

Field	Offset	Length	Description
Time left	0	4	Time left in seconds as a 4-byte integer
CheckSum	4	1	2-byte checksum of preceding four bytes (§A-4 explains checksum calculation.)

3-15. Output Data Format

- The Argonaut-ADV can output data over the serial port in a variety of formats depending on the setting of the **`OutFormat`** command (§3-7).
  - o Binary – Used for the most efficient data transmission and storage.
  - o ASCII – Standard tab-delimited ASCII format with all variables output as integers (no decimal points in data).
  - o SeaBird – Specialized format for integrating with SeaBird inductive modem.
  - o Metric – Tab-delimited ASCII format with all variables in metric units.
  - o English – Tab-delimited ASCII format with all variables in English units.
- The setting of **`OutFormat`** affects only data sent to the serial port.
- Data written to the internal recorder are always stored in binary format.
- ASCII and binary formats are used for data sent to the serial port during data collection and for data retrieved using the recorder commands.
- SeaBird, Metric, and English formats are used only for data output over the serial port during data collection.

3-15.1. Binary Data

Argonaut-ADV binary sample data uses the same format for several different methods of access.

- Output over the serial port during data collection
- Using the run-time command "**`O`**" (§3-14)
- Using the recorder command **`RSB`** (§3-10)
- Each Argonaut-ADV sample will consist of several different data records, depending on the setting of the data format parameter (**`LONG`** or **`SHORT`** – see §3-8) and whether any external sensors are installed. The data records will be in the following order.

```
Argonaut-ADV Sample     (22 or 38 bytes)
CTD Sample if present   (16 bytes)
YSI Sample if present   (16-32 bytes)
Checksum sample         (1 byte)
```

The record size can vary from 23 to 69 bytes, depending on system configuration (it is not possible to have both the CTD and YSI installed on the same system).

See Appendix A-3 for precise definitions of the binary structures used, and for an explanation of how the checksum is calculated.

3-15.2. ASCII Data

ASCII data is output in a tab-delimited format with one line of data for each sample.

- The same format is used whether output is generated during data collection, using the run-time command "**`O`**" (§3-14), or with the recorder command **`RSA`** (§3-10).
- The output is one line per sample, tab-delimited such that it gives a tabular format easily loaded by data processing software (each column of data represents a variable).
- The exact format of the output depends on the setting of the data format parameter (**`LONG`** or **`SHORT`**) and whether optional sensors are installed (CTD or YSI).

Argonaut-ADV **`LONG`** Sample Format – ASCII

Column	Contents	Units
1	Year Sample time at start of averaging interval	
2	Month	
3	Day	
4	Hour	
5	Minute	
6	Second	
7	Velocity 1 (Beam 1 / X / East)	0.1 cm/s
8	Velocity 2 (Beam 2 / Y / North)	0.1 cm/s
9	Velocity 3 (Beam 3 / Z / Up)	0.1 cm/s
10	Standard error 1 (Beam 1 / X / East)	0.1 cm/s
11	Standard error 2 (Beam 2 / Y / North)	0.1 cm/s
12	Standard error 3 (Beam 3 / Z / Up)	0.1 cm/s
13	Signal strength (Beam 1)	counts
14	Signal strength (Beam 2)	counts
15	Signal strength (Beam 3)	counts
16	Percent good pings	%
17	Heading	0.1 degrees
18	Pitch	0.1 degrees
19	Roll	0.1 degrees
20	Standard deviation heading	0.1 degrees
21	Standard deviation pitch	0.1 degrees
22	Standard deviation roll	0.1 degrees
23	Mean temperature	0.01 °C
24	Mean pressure	counts
25	Standard deviation of pressure	counts
26	Input power level	0.2 volts
27	Reserved for future use (set to 0)	
28	Range to boundary from probe tip (if detected)	0.1 cm
29-32	CTD data if installed – see below	
29-??	YSI data if installed – see below	

Argonaut-ADV **SHORT** Sample Format – ASCII

For the **SHORT** data format, several values are combined to reduce the total amount of data.

- Reported signal strength is the mean of all beams (3 for 3D probes, 2 for 2D probes).
- Reported standard error is defined based on the coordinate system.

Beam coordinates $\sigma V = \sqrt{(\sigma V1^2 + \sigma V2^2 + \sigma V3^2)}$

XYZ coordinates $\sigma V = \sqrt{(\sigma Vx^2 + \sigma Vy^2)}$

ENU coordinates $\sigma V = \sqrt{(\sigma VE^2 + \sigma VN^2)}$

Column	Contents	Units
1	Year Sample time at start of averaging interval	
2	Month	
3	Day	
4	Hour	
5	Minute	
6	Second	
7	Velocity 1 (Beam 1 / X / East)	0.1 cm/s
8	Velocity 2 (Beam 2 / Y / North)	0.1 cm/s
9	Velocity 3 (Beam 3 / Z / Up)	0.1 cm/s
10	Standard error (see above)	0.1 cm/s
11	Signal strength (see above)	Counts
12	Mean temperature	0.01 °C
13	Mean pressure	Counts
14	Input power level	0.2 volts
15-18	CTD data if installed – see below	
15-??	YSI data if installed – see below	

CTD Data Format

The CTD sensor data (if present) are given on the same line immediately following the sample data. A sample output is below (showing only the CTD data, not the rest of the sample).

```
87514   468151        0   351354
```

The data format is as follows:

- CTD temperature (units 0.0001 °C)
- CTD conductivity (units of 0.00001 Siemens per meter)
- CTD pressure (units of 0.001 decibar). Note: the CTD may not include a pressure sensor.
- CTD salinity (units of 0.0001 ppt)

YSI Data Format

The YSI output data format will be specific to the sensor installed. Contact SonTek for details.

3-15.3. SEABIRD Data

The SeaBird format is a specialized data format used when integrating the Argonaut-ADV with the SeaBird inductive modem.

- The output is one line per sample, tab-delimited such that it gives a tabular format easily loaded by data processing software (each column of data represents a variable).
- The same output format is used regardless of the setting of the **`DataFormat`** parameter. The **`DataFormat`** setting affects only data stored to the internal recorder.
- The system outputs the ASCII character "#" followed by a 1-second delay before the output of each sample.

For the SeaBird output format, several values are combined to reduce the total amount of data.

- Reported signal strength is the mean of all beams (3 for 3D probes, 2 for 2D probes).
- Reported standard error is defined based on the coordinate system.

Beam coordinates $\sigma V = \sqrt{(\sigma V1^2 + \sigma V2^2 + \sigma V3^2)}$
XYZ coordinates $\sigma V = \sqrt{(\sigma Vx^2 + \sigma Vy^2)}$
ENU coordinates $\sigma V = \sqrt{(\sigma VE^2 + \sigma VN^2)}$

Column	**Contents**	**Units**
1	Serial number	
2	Year Sample time at start of averaging interval	
3	Month	
4	Day	
5	Hour	
6	Minute	
7	Second	
8	Velocity 1 (Beam 1 / X / East)	0.1 cm/s
9	Velocity 2 (Beam 2 / Y / North)	0.1 cm/s
10	Velocity 3 (Beam 3 / Z / Up)	0.1 cm/s
11	Standard error (see above)	0.1 cm/s
12	Signal strength (see above)	Counts
13	Heading	0.1°
14	Pitch	0.1°
15	Roll	0.1°
16	Status (internal use)	

3-15.4. METRIC Data

Metric format is a special ASCII text output in a tab-delimited format with one line of data for each sample, with all data in metric units.

- The same format is used whether output is generated during data collection or using the run-time command "`O`" (§3-14).
- The output is one line per sample, and is tab-delimited such that sequential samples give a tabular format easily loaded by data processing software.
- The exact format of the output depends on the setting of the `DataFormat` parameter (`LONG` or `SHORT`) and whether optional sensors are installed (CTD or YSI).

Argonaut-ADV `LONG` Sample Format – Metric

Column	Contents	Units
1	Year Sample time at start of averaging interval	
2	Month	
3	Day	
4	Hour	
5	Minute	
6	Second	
7	Velocity 1 (Beam 1 / X / East)	cm/s
8	Velocity 2 (Beam 2 / Y / North)	cm/s
9	Velocity 3 (Beam 3 / Z / Up)	cm/s
10	Standard error 1 (Beam 1 / X / East)	cm/s
11	Standard error 2 (Beam 2 / Y / North)	cm/s
12	Standard error 3 (Beam 3 / Z / Up)	cm/s
13	Signal strength (Beam 1)	counts
14	Signal strength (Beam 2)	counts
15	Signal strength (Beam 3)	counts
16	Percent good pings	%
17	Heading	°
18	Pitch	°
19	Roll	°
20	Standard deviation heading	°
21	Standard deviation pitch	°
22	Standard deviation roll	°
23	Mean temperature	°C
24	Mean pressure	dBar
25	Standard deviation of pressure	dBar
26	Input power level	volts
27	Reserved for future use	
28	Range to boundary from probe tip (if detected)	m
29-32	CTD data if installed – see below	
29-??	YSI data if installed – see below	

Argonaut-ADV **SHORT** Sample Format – Metric

For the **SHORT** data format, several values are combined to reduce the total amount of data.

- Reported signal strength is the mean of all beams (3 for 3D probes, 2 for 2D probes).
- Reported standard error is defined based on the coordinate system.

  Beam coordinates $\sigma V = \sqrt{(\sigma V1^2 + \sigma V2^2 + \sigma V3^2)}$
  XYZ coordinates $\sigma V = \sqrt{(\sigma Vx^2 + \sigma Vy^2)}$
  ENU coordinates $\sigma V = \sqrt{(\sigma VE^2 + \sigma VN^2)}$

Column	Contents	Units
1	Year Sample time at start of averaging interval	
2	Month	
3	Day	
4	Hour	
5	Minute	
6	Second	
7	Velocity 1 (Beam 1 / X / East)	cm/s
8	Velocity 2 (Beam 2 / Y / North)	cm/s
9	Velocity 3 (Beam 3 / Z / Up)	cm/s
10	Standard error (see above)	cm/s
11	Signal strength (see above)	counts
12	Mean temperature	°C
13	Mean pressure	counts
14	Input power level	volts
15-18	CTD data if installed – see below	
15-??	YSI data if installed – see below	

CTD Data Format

The CTD sensor data (if present) are given on the same line immediately following the sample data. The data format is as follows:

- CTD temperature (°C)
- CTD conductivity (Siemens per meter)
- CTD pressure (dBar) Note: the CTD may not include a pressure sensor.
- CTD salinity (ppt)

YSI Data Format

The YSI output data format will be specific to the sensor installed. Contact SonTek for details.

3-15.5. ENGLISH Data

English format is a special ASCII text output in a tab-delimited format with one line of data for each sample, with all data in English units.

- The same format is used whether output is generated during data collection or using the run-time command "**`O`**" (§3-14).
- The output is one line per sample, and is tab-delimited such that sequential samples give a tabular format easily loaded by data processing software.
- The exact format of the output depends on the setting of the **`DataFormat`** parameter (**`LONG`** or **`SHORT`**) and whether optional sensors are installed (CTD or YSI).

Argonaut-ADV **`LONG`** Sample Format – English

Column	Contents	Units
1	Year Sample time at start of averaging interval	
2	Month	
3	Day	
4	Hour	
5	Minute	
6	Second	
7	Velocity 1 (Beam 1 / X / East)	ft/s
8	Velocity 2 (Beam 2 / Y / North)	ft/s
9	Velocity 3 (Beam 3 / Z / Up)	ft/s
10	Standard error 1 (Beam 1 / X / East)	ft/s
11	Standard error 2 (Beam 2 / Y / North)	ft/s
12	Standard error 3 (Beam 3 / Z / Up)	ft/s
13	Signal strength (Beam 1)	counts
14	Signal strength (Beam 2)	counts
15	Signal strength (Beam 3)	counts
16	Percent good pings	%
17	Heading	°
18	Pitch	°
19	Roll	°
20	Standard deviation heading	°
21	Standard deviation pitch	°
22	Standard deviation roll	°
23	Mean temperature	°F
24	Mean pressure	psi
25	Standard deviation of pressure	psi
26	Input power level	volts
27	Reserved for future use	
28	Range to boundary from probe tip (if detected)	ft
29-32	CTD data if installed – see below	
29-??	YSI data if installed – see below	

Argonaut-ADV **SHORT** Sample Format – English

For the **SHORT** data format, several values are combined to reduce the total amount of data.

- Reported signal strength is the mean of all beams (3 for 3D probes, 2 for 2D probes).
- Reported standard error is defined based on the coordinate system.

Beam coordinates $\sigma V = \sqrt{(\sigma V1^2 + \sigma V2^2 + \sigma V3^2)}$
XYZ coordinates $\sigma V = \sqrt{(\sigma Vx^2 + \sigma Vy^2)}$
ENU coordinates $\sigma V = \sqrt{(\sigma VE^2 + \sigma VN^2)}$

Column	Contents	Units
1	Year Sample time at start of averaging interval	
2	Month	
3	Day	
4	Hour	
5	Minute	
6	Second	
7	Velocity 1 (Beam 1 / X / East)	ft/s
8	Velocity 2 (Beam 2 / Y / North)	ft/s
9	Velocity 3 (Beam 3 / Z / Up)	ft/s
10	Standard error (see above)	ft/s
11	Signal strength (see above)	counts
12	Mean temperature	°F
13	Mean pressure	counts
14	Input power level	volts
15-18	CTD data if installed – see below	
15-??	YSI data if installed – see below	

CTD Data Format

The CTD sensor data (if present) are given on the same line immediately following the sample data. The data format is as follows:

- CTD temperature (°F)
- CTD conductivity (Siemens per meter)
- CTD pressure (psi) Note: the CTD may not include a pressure sensor.
- CTD salinity (ppt)

YSI Data Format

The YSI output data format will be specific to the sensor installed. Contact SonTek for details.

Section 4. Compass/Tilt Sensor Operation

The Argonaut-ADV (underwater and autonomous configurations only) can be equipped with a compass and 2-axis tilt sensor.

- This sensor provides heading, pitch, and roll data.
- The sensor used is the Precision Navigation TCM2.
- Compass data is used to translate velocity from the instrument XYZ coordinate system to an Earth coordinate system (East-North-Up or ENU).
- For more information about the ENU coordinate system, see Section 4-3.
- See Section 4-1 for details about testing basic compass operation.

While the compass provides excellent quality data, there are some limitations to keep in mind.

- The compass must be correctly installed for the orientation of the Argonaut-ADV (up- or down-looking)
- The system remains within the ±50° limit of the tilt sensor.
- See Section 4-2 for details about compass installation.

The compass includes a built-in calibration feature to account for the effects of ambient magnetic fields (i.e., nearby ferrous metals).

- We recommend performing a compass calibration before each deployment.
- When properly calibrated, the compass provides heading accurate to ±2.0°, and pitch and roll accurate to ±1.0° up to 50°.
- See Section 4-4 for details about compass calibration.

Because the compass communicates with the Argonaut-ADV system through an RS-232 interface, it is possible for the user to communicate directly with the compass.

- All communication with the compass is done automatically by the Argonaut-ADV.
- Direct communication with the compass should not normally be necessary.
- Section 4-5 explains how to communicate directly with the compass/tilt sensor.

4-1. Testing Compass Operation

This section describes a simple procedure to verify compass operation using a continuous display of heading, pitch, and roll. The display can be obtained using the direct-command interface or the compass calibration software.

- Start the display of compass data.
- If using the direct-command interface, the command **`Compass CONT`** gives a continuous output of heading, pitch, and roll (§3-12).
- The compass calibration software (see the *Argonaut-ADV Software Manual*) provides a graphical display of compass data.
- Point the Argonaut-ADV X-axis (§6-4.2) towards each compass direction (North, South, East, and West).
- Compare the compass output with the expected reading. Remember that the Argonaut-ADV reports heading relative to magnetic north.
- Test the pitch and roll sensors by tilting the Argonaut-ADV about the X-axis (roll) and Y-axis (pitch) respectively.
- Compare the output measurements with estimated tilt angles.

The compass must be oriented up (which means the Argonaut-ADV will be oriented down if the compass is installed for down-looking operation), and the orientation setting must match the compass installation. See Section 4-2 for details about compass installation and orientation.

- This test should be conducted in an area predominantly free of magnetic material (i.e., ferrous metals).
- The data should appear reasonable within the accuracy of this type of experiment (±10° heading, ±5° tilt).
- Large errors or a lack of response indicates a problem with the compass.
- This is not intended as a precise test, but a means to evaluate basic performance.
- For best results, we recommend performing a compass calibration before any deployment (§4-4).

4-2. Compass Installation

The Argonaut-ADV is configured at the factory for up or down-looking operation based on user requirements.

- Down-looking operation is defined as the probe and mounting stem being **below** the Argonaut-ADV processor housing.
- Up-looking operation is defined as the probe and mounting stem being **above** the Argonaut-ADV processor housing.
- **Precise compass alignment is performed at the factory; compass installation should not be modified by the user.**
- Contact SonTek if you need to switch between up and down-looking operation.

You can determine the compass orientation by using the **`Show Conf`** command from the direct-command interface (§3-13 and §5-1).

The critical part of compass installation is to maintain a known orientation relative to the probe. This allows the Argonaut-ADV to use the compass data to translate velocity data from the XYZ coordinate system (relative to the Argonaut-ADV) to the ENU coordinate system.

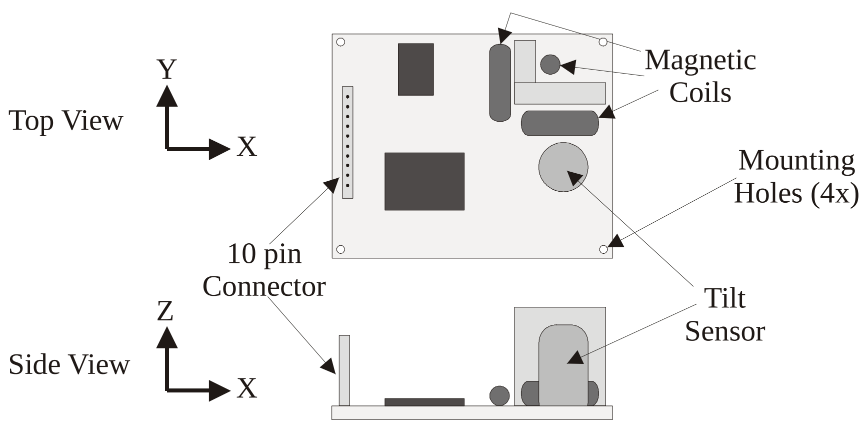

Figure 5 – Compass/Tilt Sensor and XYZ Coordinate System

Figure 5 shows the compass/tilt sensor and its XYZ coordinate system.

- The compass must be operated with the component side facing upwards (within the ±50° tilt limit); operation in any other orientation will result in invalid compass data and corrupted velocity data using the ENU coordinate system.
- The compass X-axis is aligned with the probe X-axis at the factory using a combination of hardware and software settings.
- Heading is defined based on the probe X-axis. That is, when heading reads 0°, the X-axis is pointing north.
- Pitch is defined as a rotation about the Y-axis.
- Roll is defined as a rotation about the probe X-axis.

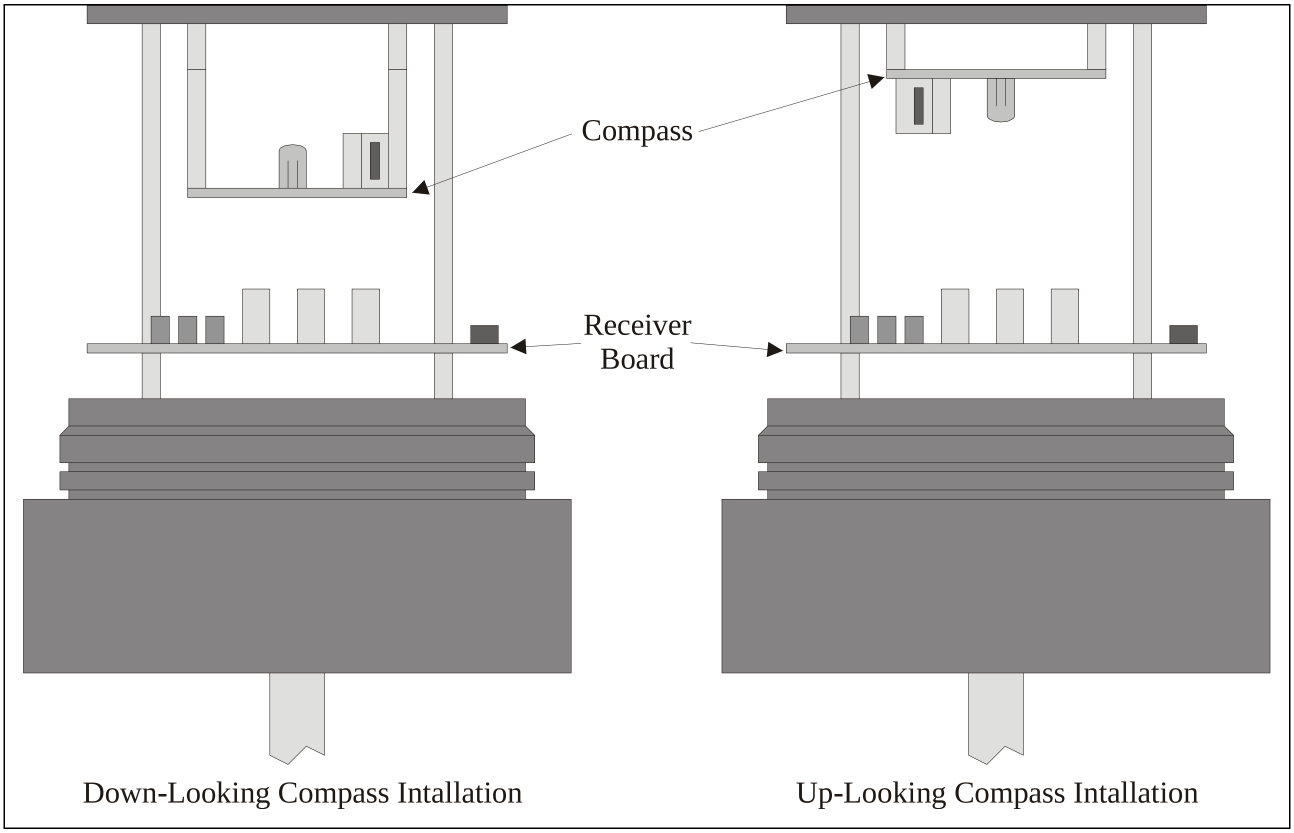

Figure 6 – Compass Installation for Up and Down-Looking Operation

Figure 6 shows the installation of the Argonaut-ADV compass/tilt sensor for down-looking and up-looking operation. The system is drawn with the probe looking down.

As mentioned previously, compass installation should not be modified by the user. Contact SonTek if you wish to switch between up and down-looking operation.

4-3. The ENU Coordinate System

The primary advantage of using the compass is the ability to report velocity data in Earth coordinates – independent of the orientation of the Argonaut-ADV.

- When using the Earth (ENU or East/North/Up) coordinate system, velocity is reported in Earth coordinates regardless of the physical orientation of the Argonaut-ADV.
- An Argonaut-ADV mounted with an unknown orientation will provide velocity data consistent with the direction and speed of the water current itself.
- Proper compass operation requires correct installation as described in Section 4-2, and operation within the ±50° tilt limitation.

The translation of velocity data to Earth coordinates is enabled or disabled through commands to the Argonaut-ADV and is transparent to the user.

- Selection of the coordinate system is done using the **`CoordSystem`** command (§3-8) or by a menu item in the data acquisition software (see *Argonaut-ADV Software Manual*).
- When the compass is installed, heading, pitch, and roll data are stored with each sample if the **`DataFormat`** parameter is set to **`LONG`** (§3-8).
- Compass data are not stored using the **`SHORT`** data format (§3-8).

The Argonaut-ADV performs vector-averaging using compass data during each sample.

- Argonaut-ADV velocity data in each sample are averaged using continually updated compass data.
- If the Argonaut-ADV changes orientation during a sample, velocity data will be averaged in Earth coordinates and will not be contaminated by instrument motion.
- Using any other coordinate system for the Argonaut-ADV (BEAM or XYZ) eliminates this Earth coordinate system vector averaging and can contaminate data if the instrument moves during the course of an averaging interval.

4-4. Compass Calibration

The compass can be calibrated to compensate for ambient magnetic fields, which may cause errors in heading measurements.

- Magnetic distortion is most-commonly caused by ferrous metals.
- If the Argonaut-ADV is mounted on or near anything that contains magnetic material or that generates a magnetic field, the compass should be calibrated before starting data collection.
- The compass should be calibrated when moved to a different environment or mounting apparatus.
- We recommend calibrating the compass before each deployment.

There are two methods for compass calibration. The first is to use the compass calibration software, described in the *Argonaut-ADV Software Manual*. Alternatively, you can use the compass commands from the direct-command interface, as described here. The two methods achieve identical results.

- Establish communication with the Argonaut.
- Enter the **`Compass CAL`** command.
- The system will output basic instructions for the calibration and give a continually updated output of heading, pitch, and roll.
- The compass is now in multiple-point calibration mode and is collecting sample points.
- Rotate the compass slowly through 360 degrees at least twice, varying the pitch and roll as much as possible, so that a complete rotation takes at least one minute to complete.
- When this has been completed, press any key to terminate the calibration.
- The Argonaut-ADV will respond with a calibration score, which will look like the following.

```
H9V9M5.3:
```

- This is an indication of the quality of the calibration.
- The number following the 'H' and 'V' should be high (scale of 0 to 9) and the number following the 'M' should be low (on a scale of 0 to 100).
- The number following the H reflects the quality of the horizontal calibration.
- The number following the V reflects the quality of the vertical calibration.
- The number following the M reflects the amount of magnetic distortion present.
- While scores will vary, you should repeat the calibration if H or V is below 6, or if M is greater than 30.0. If the results do not improve, consider changing the location or modifying the mounting structure.

The compass calibration software follows an essentially identical procedure, and reports the same calibration score (see the *Argonaut-ADV Software Manual* for details.)

4-5. Communicating with the Compass

All compass communication is handled automatically by the Argonaut-ADV. Under normal circumstances, you should not need to communicate directly with the compass. However, should communication be necessary, you can “talk” to the compass through the Argonaut-ADV.

- Establish communication with the Argonaut-ADV.
- Send the following command to establish a direct link with the compass.

```
echo 1
```

- If the compass is operating properly, it should be continuously sending data to the Argonaut, which will be redirected to the user. The data will look something like:

```
$C143.2P3.4R5.4T24.5*3f
```

- The compass will now accept direct commands.
- For details on communicating with the compass, or for a copy of the compass manual, contact SonTek.
- When communication with the compass is no longer desired, typing three plus signs in succession (“+++”) or sending a **BREAK** will return the Argonaut-ADV to command mode.

Section 5. Argonaut-ADV Hardware

5-1. Hardware Configuration Settings

Hardware configuration settings can be displayed using the **`Show Conf`** command from the direct-command interface (§3-13). A sample output is given below.

```
>show conf+

HARDWARE CONFIGURATION PARAMETERS
---------------------------------
System Type -------------------- ADV
Sensor serial # ---------------- A263
Sensor frequency – (kHz) ------- 10000
Number of beams ---------------- 3
Beam Geometry ------------------ 3_BEAMS
Slant angle – (deg) ------------ 15.0
Orientation -------------------- DOWN
Compass installed  ------------- NO
Recorder installed ------------- YES
Temperature sensor ------------- YES
Pressure    sensor ------------- NO
Ctd         sensor ------------- NO
PressOffset  – (dbar) ---------- 0.000000
PressScale  -- (dbar/count) ---- 0.000000
PressScale_2 – (pdbar/count^2) – 0
Waves Option ------------------- NO
```

- Serial number: Stamped on the probe end cap.
- Frequency: Lists the acoustic frequency of the Argonaut-ADV.
- Number of beams / Beam geometry / Slant angle: The Argonaut-ADV use 2 or 3 beams for 2D or 3D probes. The nominal beam angle is 15°. See the *Argonaut-ADV Principles of Operation* for details on the beam geometry used.
- Orientation: Measurement orientation of the system for up-looking or down-looking operation. This setting matches the compass installation (§4-2). Also, note that the orientation will affect the definition of the XYZ coordinate system (§6-4).
- Compass / Recorder / Temperature / Pressure / CTD: These specify which sensors have been installed. All systems include the recorder and temperature sensor.
- PressOffset / PressScale / PressScale_2: Pressure sensor calibration parameters (§3-11, §6-7).

5-2. Internal Electronics and Wiring Overview

This section provides information about the internal layout of the Argonaut-ADV. For more information, see the following sections.

- Section 4-2 – Compass installation
- Section 5-3 – Argonaut-ADV processor
- Section 5-6 – Accessing electronics

5-2.1. Underwater / Autonomous Argonaut-ADV Configurations

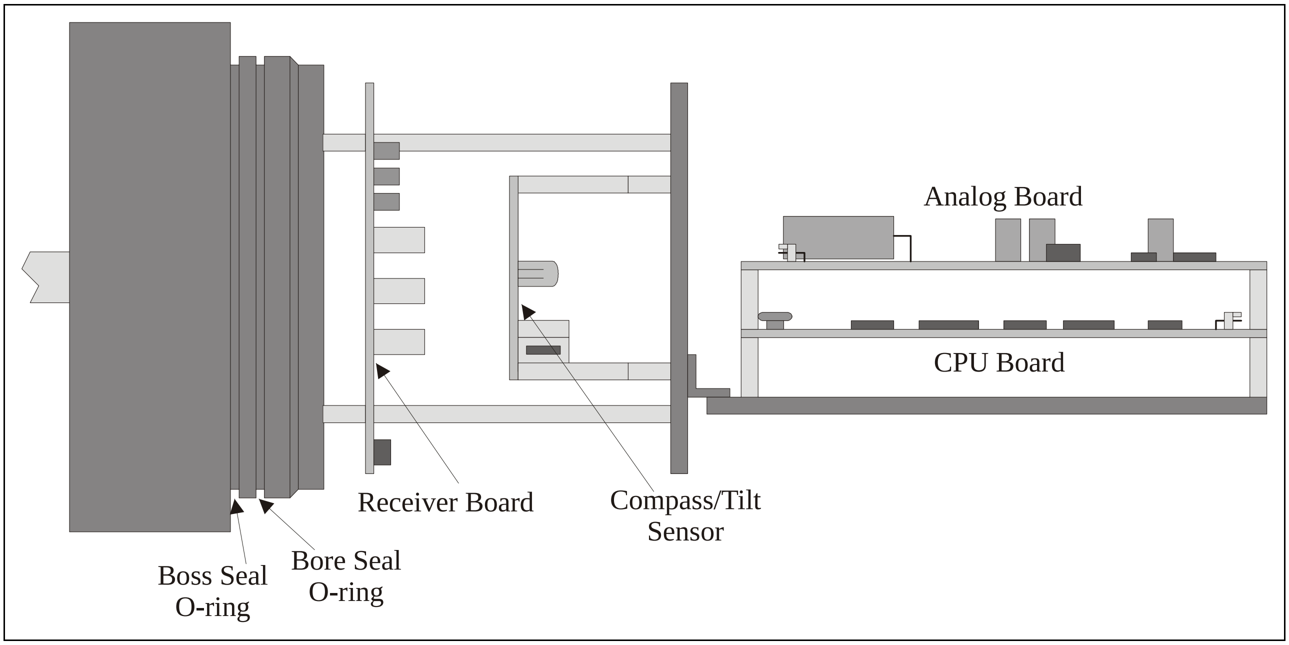

Figure 7 – Internal Electronics (Underwater and Autonomous Configurations)

Figure 7 shows the internal layout of the Argonaut-ADV for the underwater and autonomous configurations. The system is shown with the mounting stem and probe to the left, and the optional compass/tilt sensor installed for down-looking operation (§4-2).

- Dual o-ring seals are mounted on the inside of the end cap. When opening the system, take care to avoid damage to o-rings and surfaces. Clean and inspect o-rings and surfaces before closing the system.
- The receiver board is mounted on three 3/8” standoffs mounted directly to the end cap. The transducers are permanently wired to the receiver board.
- An internal mounting frame for the compass/tilt sensor and Argonaut-ADV processor is mounted on three 2½” standoffs attached to the receiver board.
- The compass/tilt sensor is mounted above the receiver board (§4-2).
- The processor (analog and CPU boards) is mounted on two sets of four ½” standoffs. The analog board is on top of the CPU board. The two boards connect via an edge connector at the right end (as shown in Figure 7). See Section 5-3 for a description of the processor.
- Autonomous configurations have a battery pack mounted just past the processor boards (not shown).

The cables used to connect the different portions of the Argonaut-ADV are described below. For details about the location of each connector on the Argonaut-ADV processor, see Section 5-3.

- A 16-pin ribbon cable connects the receiver board to the analog board. The cable uses the same connectors at each end with pin-to-pin wiring, so it can be installed in either direction. The keyed connectors can be installed in only one direction.
- The compass/tilt sensor interface cable goes from a 10-pin red connector on the compass to a keyed, 5-pin, red connector on the CPU board (labeled *Compass*).
- A 2-wire cable from the temperature sensor connects to a keyed, 2-pin, red connector on the analog board (labeled *Temperature*).
- A 5-wire cable from the pressure sensor (if installed) connects to a keyed, 5-pin, red connector on the analog board (labeled *Pressure*).
- The DC power supply is connected to a keyed, 3-pin, red connector on the analog board. Power from the Argonaut-ADV batteries is wired directly to the analog board. External power is wired through an additional voltage regulator (installed on the internal mounting hardware) before reaching the connector on the analog board. See Section 6-1 for input power specifications.
- RS232 or RS422 serial communication is wired from the underwater connector on the end cap to a keyed, 5-pin, red connector on the CPU board (labeled *User*).
- A red 3-pin connector on the CPU board is used for the RS232 interface to the optional integrated CTD or YSI sensor.

5-2.2. Splash-Proof Argonaut-ADV Configuration

The receiver electronics for the Argonaut-ADV splash-proof configuration are housed in a separate submersible housing physically connected to the probe.

- The probe and receiver electronics are connected to the splash-proof processor housing by the probe cable. This cable is a custom built, noise sensitive cable and should not be modified by the user.
- The receiver electronics have no user-serviceable parts and are not described here.

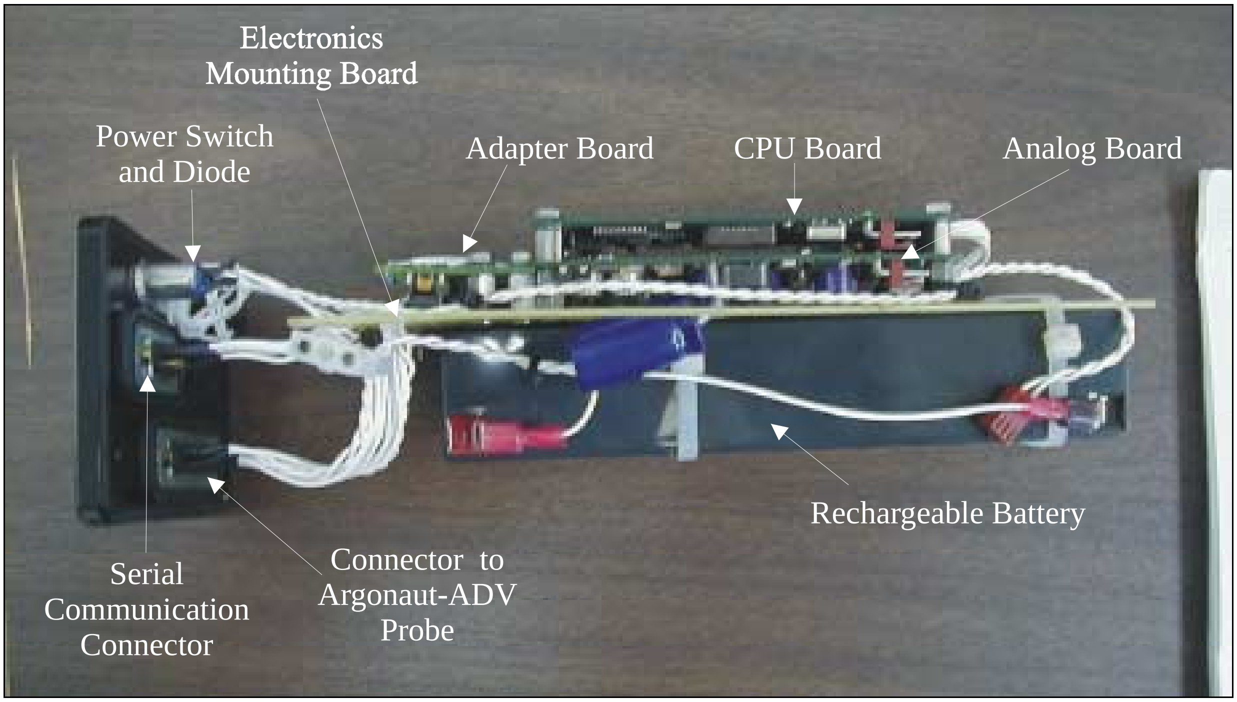

Figure 8 – Internal Electronics (Splash-Proof Configuration)

Figure 8 shows the internal electronics in the splash-proof processor housing.

- The wiring inside the splash-proof electronics is complex and delicate. The internal electronics should not normally be accessed by users. Please contact SonTek before accessing the splash-proof electronics.
- All components inside the splash-proof housing are attached to a mounting board that slides into extruded groves in the housing.
- The processor (analog and CPU boards) is mounted to one side of the mounting board.
- The internal rechargeable battery is installed on the other side of the mounting board.
- Wiring to the Argonaut-ADV probe, serial interface connector, power switch, and power indicator diode is connected to the front panel of the splash-proof housing.
- Wiring from the battery charger is connected via the back panel of the splash-proof housing (not shown here).

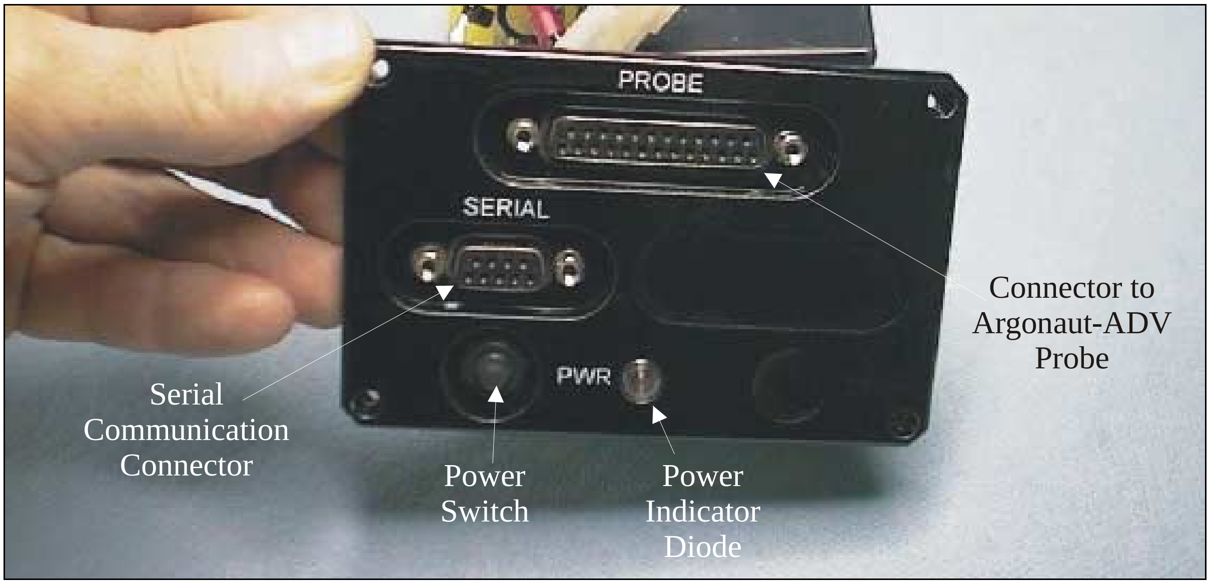

Figure 9 – Splash-Proof Housing Front Panel

The front panel of the splash-proof housing (Figure 9) has four items of interest.

- The DB25 female connector matches the probe cable to connect the processing electronics to the probe and receiver electronics.
- The DB9 female connector matches the serial communication cable to the controlling computer or data logger. See Section 5-5.2 for a wiring diagram.
- A toggle switch is used to switch the Argonaut-ADV on and off. The switch isolates the Argonaut-ADV processor from the internal battery and battery charger input. The battery can be charged while the switch is off. The Argonaut-ADV can collect data while the battery is charging.
- An indicator diode shows when the system is on or off. The diode will go off if the system enters sleep mode (i.e., if inactive in command mode for more than 5 minutes).

The back panel of the splash-proof housing (not pictured here) has two items of interest.

- A coaxial connector matches the battery charger supplied with the system. Batteries can be charged while operating the system. See Section 5-7.3 for details on the rechargeable batteries.
- A small vent plug should be opened any time the battery charger is connected (§5-7.3).

5-3. Argonaut-ADV Processor

The Argonaut-ADV processor consists of two printed circuit boards called the analog and CPU boards. Mounting of the Argonaut-ADV processor is described in Section 5-2.

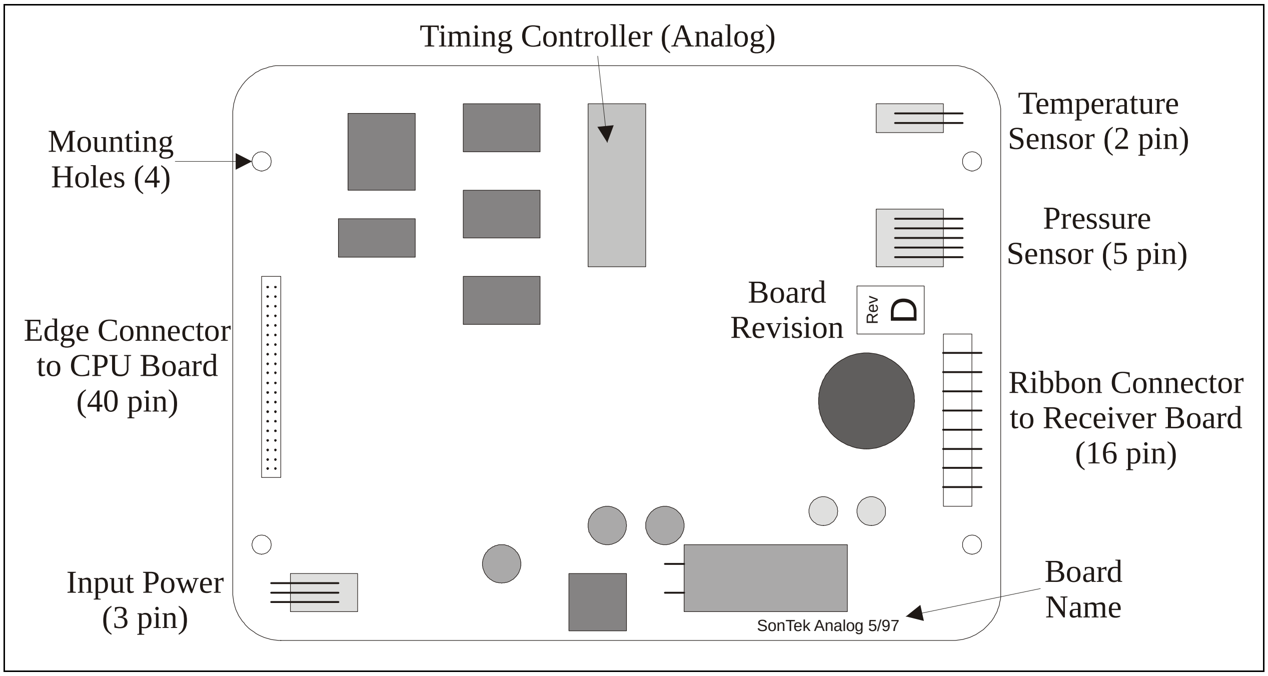

Figure 10 – Argonaut-ADV Processor Analog Board

Figure 10 shows the layout of the analog board.

- A keyed, 3-pin, red connector (labeled Power) is connected to the input power wiring. See Section 6-1 for input power specifications.
- A 40-pin edge connector mates below to the CPU board.
- A keyed, 2-pin, red connector (labeled Temperature) connects to the temperature sensor in the probe.
- A keyed, 5-pin, red connector (labeled Pressure) connects to the pressure sensor (if installed) in the end cap.
- A keyed, 16-pin connector (not labeled) connects to a ribbon cable to the receiver board.
- A programmable logic chip (called the analog timing controller) on the top center of the board is used to control the timing of the Argonaut-ADV transmit/receive circuitry. The chip is mounted in a socket to simplify installation. Upgrades for the analog timing controller may be periodically available; see Section 5-6.3 for installation instructions.
- The board includes four holes for mounting, which match the mounting holes in the CPU board and are used with a set of #4-40 screws and standoffs.
- The board revision is printed on the middle right portion of the board. The board name is shown in the bottom right corner.

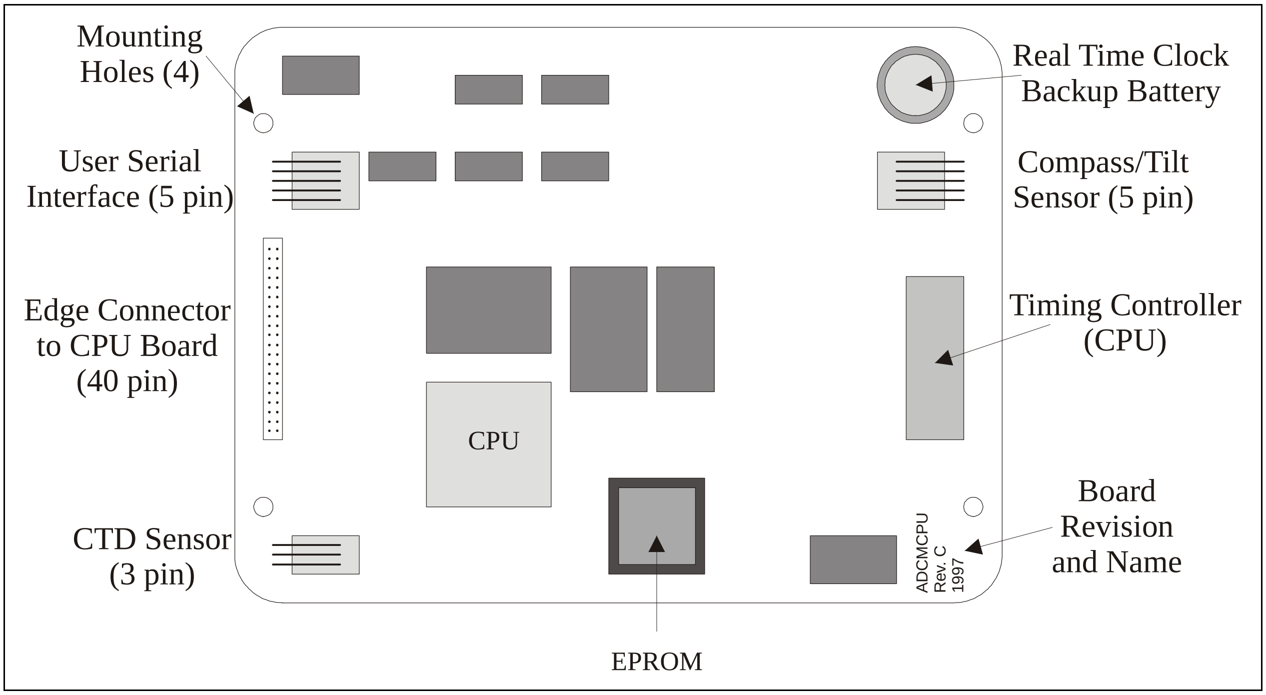

Figure 11 – Argonaut-ADV Processor CPU Board

Figure 11 shows the layout of the CPU board.

- A 5-pin, red connector (labeled User) connects to the Argonaut-ADV underwater connector for the external serial communication interface (RS232 / RS422 / RS485 / SDI-12).
- A 5-pin connector (labeled Compass) provides the power and RS232 interface to the internal compass/tilt sensor (if installed).
- A 40-pin edge connector mates above to the analog board.
- A 3-pin, red connector (labeled CTD) connects the RS232 interface to the optional integrated CTD or YSI sensor.
- The backup battery is installed in the upper right hand corner of the board. This is used to supply the real-time clock when main power is not available. See Section 6-2 for details.
- The EPROM containing the software to control Argonaut-ADV operation is installed in a socket in the bottom center of the board. Upgrades for the Argonaut-ADV CPU EPROM may be periodically available. See Section 5-6.3 for details.
- The system CPU, the main computational power of the Argonaut-ADV, is mounted in the bottom center of the board, just above and to the left of the CPU EPROM.
- A programmable logic chip (called the CPU timing controller) on the top center of the board is used to control the timing of all Argonaut-ADV operations. The chip is mounted in a socket to simplify installation. Upgrades for the CPU timing controller may be periodically available. See Section 5-6.3 for installation instructions.
- The board name and revision are printed in the bottom-right corner.

5-4. Communication Baud Rate Setting

The Argonaut-ADV communication baud rate, normally 9600 baud, is set at the factory and should not normally need to be changed. However, for some specialized applications, you may wish to set a different baud rate. This can be done by a special command from the direct-command interface. The command format is shown below. See Section 3 for details about the direct-command interface.

`UserDefaultBaudRate Set [baud rate]`

- Default parameter: **`9600`**
- Parameter range: **`1200`**, **`2400`**, **`4800`**, **`9600`**, **`19200`**, **`38400`**, **`57600`**, and **`115200`**
- Without parameter: returns its current setting.
- If given with a valid parameter in the form shown above, sets the baud rate to this value.
- If the command is recognized as valid, the system will transmit an "**`OK`** <CR><LF>" followed by the command prompt "**`>`**" at the old baud rate setting. All further communication is done using the new baud rate. The setting is used until a new value is set.
- Note that the command **`Defaults`** (§3-7) does <u>not</u> reset the communication baud rate.

SonTek software operates assuming a baud rate setting of 9600. If another baud rate setting is used, you will need to specify this in the software program. See the *Argonaut-ADV Software Manual* for details on specifying the communication baud rate.

5-5. Cables and Connectors

5-5.1. Underwater / Autonomous Argonaut-ADV Configurations

The Underwater and Autonomous Argonaut-ADV systems use the same cables and connectors for external power and communication.

- The 8-pin, underwater-mateable connector is manufactured by Impulse Enterprises.
- The bulkhead connector (on the instrument housing) part number is BH-8-FS.
- The cable connector part number is IL-8-MP (with locking sleeve).
- The address for Impulse Enterprises is:

  Impulse Enterprises Phone: (619) 565-7050
  8254 Ronson Road Fax: (619) 565-1649
  San Diego, CA 92111 USA

The following table describes the Argonaut-ADV power and communication cable wiring. Note that two different types of underwater cable are used, with some variation in wire color.

Pin number	Wire color	Function RS232	Function RS422 / RS485	Function SDI-12
1	Red	External power (6-30 VDC; §6-1)	External power (6-30 VDC; §6-1)	External power (6-30 VDC; §6-1)
2	White	Data out	Tx+	Data out (RS232)
3	Violet[1] / Black (w/ white)[2]	Data in	Tx-	Data in (RS232)
4	Orange[1] / Black (w/yellow)[2]	External Sensor Power (§6-1)	External Sensor Power (§6-1)	SDI-12 select (Appendix C)
5	Yellow	External battery (see below & §6-1)	External battery (see below & §6-1)	External battery (see below & §6-1)
6	Green	Not used	Rx+	SDI-12 data (Appendix C)
7	Blue[1] / Black (w/green)[2]	Not used	Rx-	Not used
8	Black[1] / Black (w/ red)[2]	Ground	Ground	Ground

[1] – Indicates the color for cables longer than 10 meters; the cable's outer diameter is 1.2 cm (0.45 in.).
[2] – Indicates the color for cables 10 meters long or shorter; the cable's outer diameter is 0.8 cm (0.3 in). Note that this cable has several black wires in twisted pairs; they are differentiated by the color of the other wire in the twisted pair (e.g., black with yellow).

- Data transfer is listed relative to the Argonaut-ADV: Data Out or Tx refers to data sent by the Argonaut; Data In or Rx refers to commands received by the Argonaut.
- Wiring is shown for all serial communication protocols. See Sections 3-1 and 6-5 for information about serial communication protocol.
- See Appendix C for details about SDI-12 operation.

Note that there are two different input power pins.

- Pin 1 is the external power input. This pin can accept input voltages from 8 to 30 VDC.
- Pin 5 is the external battery input.
- For all systems except those with rechargeable batteries: The voltage from Pin 5 goes directly to the Argonaut-ADV processor and must be in the range 6 to 15 VDC. Voltages above 15 VDC on this pin will severely damage the Argonaut-ADV electronics.
- For systems with rechargeable batteries: The voltage from Pin 5 goes through a DC-to-DC converter. This voltage is used to charge the internal batteries and operate the system. The input voltage must be in the range 10 to 18 VDC; current draw when charging the batteries can be as high as 2 A. Only the SonTek supplied battery charger should be used.
- See Sections 6-1 and 8-2 for details about input power specifications and power consumption.

RS232

- When using RS232 serial communication, the user end of the power and communication cable is terminated with a DB9 female connector for serial communication and a coaxial power plug for external DC input power.
- The center pin of the coaxial power connector serves as positive (+); the outer shield is negative (–). Different types of coaxial connectors are used depending on the system type.
- For systems with no batteries or alkaline batteries, power from the coaxial connector is wired to Pin 1 (external power) and can accept 8 to 30 VDC. The power supply included with the system (matching this coaxial plug) supplies 24 VDC.
- For systems with rechargeable batteries, power from the coaxial connector is wired to Pin 5 (external battery). This should only be used with the battery charger / power supply included with the system.
- The DB9 female connector is wired to be compatible with standard PC serial communication ports as shown in the following table.

RS232 Serial Communication DB9 Female Connector Wiring

Pin #	Signal	Pin #	Signal	Pin #	Signal
1	Not used	4	Not used	7	Not used
2	Data Out (to Pin 2 of IL-8-MP)	5	Ground (to Pin 8 or IL-8-MP)	8	Not used
3	Data In (to Pin 3 of IL-8-MP)	6	Not used	9	Not used

RS422 / RS485

- When using RS422 or RS485 serial communication, the power and communication cable is terminated with a coaxial power plug and a DB25 connector wired for RS422/RS485.
- The center pin of the coaxial power connector serves as positive (+); the outer shield is negative (–). Different types of coaxial connectors are used depending on the system type.
- For systems with no batteries or alkaline batteries, power from the coaxial connector is wired to Pin 1 (external power) and can accept 8 to 30 VDC. The power supply included with the system (matching this coaxial plug) supplies 24 VDC.
- For systems with rechargeable batteries, power from the coaxial connector is wired to Pin 5 (external battery). This should only be used with the battery charger / power supply included with the system.
- RS422/RS485 systems include a RS232/RS422 converter and a DB25/DB9 converter.
- The end of this chain is a DB9 connector wired for RS232 as shown in the preceding table. This allows the cable to be connected to a PC's serial communication port.

SDI-12

- There are two different configurations for SDI-12 systems – internal or external conversion.
- Systems manufactured before September, 2000 use external conversion; systems manufactured after this date use internal conversion.
- See Appendix C for details about both types of systems.

External Sensor Wiring

For systems with external sensors (CTD or YSI), a special splitter cable is used to route power and serial communication to the external sensor.

- One end of the cable connects to the Argonaut-ADV.
- Another end of the cable connects to the external sensor (CTD or YSI).
- The third end of the cable connects to the standard power and communication cable described above.

The following table describes the wiring of the splitter cable for the SeaBird MicroCat CTD. All part numbers are for Impulse Enterprises connectors.

Argonaut-ADV Connector (IL-8-MP)	Function	MicroCat Connector (RMG-4-FS)	To Power/Comm. Cable (IL-8-FS)
Pin 1	External Power	Not connected	Pin 1
Pin 2	RS232 Data Out	Not connected	Pin 2
Pin 3	RS232 Data In	Not connected	Pin 3
Pin 4	Sensor Power	Pin 4	Not connected
Pin 5	External Batteries	Not connected	Pin 5
Pin 6	Data to MicroCat	Pin 2	Pin 6
Pin 7	Data from MicroCat	Pin 3	Pin 7
Pin 8	Ground	Pin 1	Pin 8

Wiring for external YSI sensor varies with instrument configuration; contact SonTek for details.

5-5.2. Splash-Proof Argonaut-ADV Configuration

The front panel of the Argonaut-ADV splash-proof housing has two connectors, a power switch, and a power indicator light.

The DB25 connector mates with the probe cable from the Argonaut-ADV probe. This high-frequency cable is a custom-shielded cable that is very sensitive to noise. Neither the cable nor the connector should be modified without contacting SonTek.

The toggle switch turns the system on and off (making or breaking the connection between the Argonaut-ADV processor and internal rechargeable battery). The battery can be charged (using the battery charger input on the back panel) whether the power switch is on or off.

The diode on the front panel will light if the system is powered up. Note that the diode will turn off if the system enters the sleep mode (even if the power switch is on).

The DB9 connector provides access to the RS232 serial communication lines. This connector has been wired following standard serial communication protocol. A simple pin-to-pin cable can be used to connect the Argonaut-ADV to the DB9 serial port on a PC-compatible computer (a ribbon cable is provided with the system for this purpose). The following table gives the pin-out for the DB9 connector.

RS232 Serial Communication DB9 Connector Wiring

Pin #	Signal	Pin #	Signal	Pin #	Signal
1	Not used	4	Not used	7	Not used
2	Data Out	5	Ground	8	Not used
3	Data In	6	Not used	9	Not used

The back panel of the splash-proof housing has one connector and a vent plug.

- A coaxial connector matches the battery charger supplied with the system (center pin is positive voltage; outer shield is negative). Batteries can be charged while the system is operating. See Section 5-7.3 for details on the rechargeable batteries.
- The vent plug should be opened any time the battery charger is connected (§5-7.3).

5-6. Accessing Electronics

This section contains basic instructions for opening the Argonaut-ADV electronics housings. However, the Argonaut-ADV should not need to be opened on a regular basis. The most common reason for opening the Argonaut-ADV is to replace the battery pack (§5-7).

5-6.1. Underwater / Autonomous Argonaut-ADV Configuration

To open the underwater or autonomous Argonaut-ADV, use the following steps.

1. Perform all maintenance in a static-free environment.
2. See Section 5-2.1 for a description of the internal layout of the Argonaut-ADV. See Section 5-3 for a description of the Argonaut-ADV processor.
3. Remove the three screws holding the end cap to the underwater housing.
4. Remove the end cap. Because of the bore seal o-ring, the end cap may be difficult to remove from the pressure housing. If necessary, have one person hold the housing while another rocks the end cap back and forth.
5. Pull the end cap with attached internal electronics out of the underwater housing, taking care not to catch or pull on the internal wiring.
6. Only if necessary, disconnect the internal wiring harness from the electronics and batteries (if installed). Unique, keyed connectors are used for each.
7. While open, protect all o-rings and o-ring surfaces from damage.

When installing the end cap with electronics, use the following steps.

1. Clean and inspect all o-rings and o-ring surfaces for damage; replace o-rings if necessary.
2. Re-connect the internal wiring harness to the electronics (if removed).
3. Inspect the desiccant pack secured to the electronics mounting hardware. Replace if necessary.
4. If possible, purge the underwater housing with a dry, inert gas (nitrogen, argon).
5. Slide the electronics assembly back into the underwater housing, taking care to avoid catching wires or damaging o-rings or o-ring surfaces.
6. Secure the end cap to the underwater housing using the three screws.

5-6.2. Splash-Proof Argonaut-ADV Configuration

The internal electronics and wiring of the splash-proof Argonaut-ADV are compact and delicate. Take care whenever opening the system.

1. Perform all maintenance in a static-free environment.
2. See Section 5-2.2 for a description of the internal layout of the splash-proof Argonaut-ADV. See Section 5-3 for a description of the Argonaut-ADV processor.
3. Remove the four screws holding the front panel to the splash-proof housing.
4. Remove the front panel from the housing. Because of the sealing gasket, it may be difficult to pull off. If necessary, a small screwdriver can be used to start the separation.
5. Note that the internal electronics are also connected to the back panel, so you will only be able to remove the electronics just past the front of the splash-proof housing.
6. Pull the front panel forward slowly, sliding the electronics/battery assembly out of the housing.
7. Make note of which slot in the housing holds the mounting board.

When reinstalling the electronics into the splash-proof housing, use the following steps.

1. Insert the electronics mounting board into the appropriate slot in the splash-proof housing. Note that only one slot will align the electronics and battery to fit within the housing.
2. Slowly slide the electronics into the housing, taking care not to catch any wires.
3. Align the gasket to fit correctly between the front panel and the splash-proof housing.
4. Secure the front panel to the splash-proof housing using the four screws.

5-6.3. Replacing the CPU EPROM and Other Programmable Chips

The Argonaut-ADV processor includes three programmable chips: the CPU EPROM, the analog timing controller, and the CPU timing controller.

- See Section 5-3 for the location and a description of the function of each of these chips.
- Upgrades (most commonly the CPU EPROM) may be periodically available from SonTek.
- Basic installation instructions are given below.
- See sections 5-2 and 5-3 for a description of the internal mounting, wiring, and Argonaut-ADV processor.

Downloadable CPU firmware

- Systems produced after September, 2000 will have downloadable firmware.
- Firmware upgrades can be performed by simply connecting the system to a computer and running the appropriate software, without physically installing a new chip.
- For downloadable firmware upgrades, all needed software and instructions will be provided with the upgrade.

Accessing the processor

- Perform all maintenance in a static-free environment.
- Access the system electronics using the instructions in Section 5-6.1 and 5-6.2.
- Make note of the orientation of the processor boards before removing it.
- Remove all connectors from the analog board.
- Remove the four #4-40 screws that hold the analog board to the CPU board.
- Lift the analog board straight up to disconnect the edge connector going to the CPU board. Take care not to bend or damage any pins on the connector.
- Remove all connectors from the CPU board.
- Remove the four hex standoffs that hold the CPU board to the mounting hardware.

Replacing the CPU EPROM

- A special chip removal tool (called a PLCC extractor) will simplify the removal of the old chip. With this tool, the two ends are placed on two corners of the socket; compressing the tool lifts the EPROM from the socket.
- Alternatively, a very small flat blade screwdriver can be used to remove the old chip. Insert the screwdriver in the slots in each corner and slowly work the chip up (alternating from opposite corners) until it comes free of the socket.
- When installing the new chip, align the rounded corner of the chip with the similar corner of the socket.
- Lay the chip on the socket and align each pin with the corresponding groove.
- Firmly press the chip into the socket until it is securely set.
- Keep the old EPROM in a static-safe bag until you have verified system operation (after verifying operation it can be discarded).

Replacing the analog / CPU timing controller

- Chips for the analog and CPU timing controller use the same package, but are not interchangeable.
- Be certain that you install the correct chip in the correct socket when replacing these controllers, or the system will not operate.
- Either timing controller chip can be removed using a small flat blade screwdriver.
- Carefully pry each edge of the chip up until you can lift the chip by hand.
- When installing the new chip, align the semicircle on the chip with the semicircle shown on the socket and circuit board.
- Take care not to bend or damage any pins when installing the chip.
- Seat the chip securely by hand.
- Keep the old chip in a static-safe bag until you have verified system operation (after verifying operation the chip can be discarded).

Assembling the processor

- Install the CPU board on the internal hardware and secure with the four hex standoffs. Make sure to install the board with the same alignment used before removing the boards.
- Connect all appropriate internal wiring to the CPU board. See Section 5-3 for details on internal connectors.
- Install the analog board on top of the CPU board. Carefully align all pins on the edge connector, seat the connector securely, and secure the analog board with four #4-40 screws.
- Connect all appropriate internal wiring to the analog board. See Section 5-3 for details on internal connectors.
- Close the system following instructions in Sections 5-6.1 and 5-6.2.

Verifying system operation after a change

- Following any EPROM or timing controller change, you should immediately verify basic system operation.
- After closing the system, connect the power and communication cable, and then apply power to the system.
- Test the operation of the transducers in water using the system diagnostic software (ArgCheck or ArgADVCk – see the *Argonaut-ADV Software Manual*).
- Run the real-time data collection software as described in the *Argonaut-ADV Software Manual*. Set the instrument for a short averaging time (10 seconds) and begin data collection. Place the probe in a small tank of water with some seeding material, and move the probe to verify the basic collection of velocity data.
- Verify temperature and (optional) pressure sensor operation by checking data output (either with the real-time software or through a terminal emulator using the **`Sensor CONT`** command).
- Verify (optional) compass/tilt sensor operation using the compass calibration software or through a terminal emulator using the **`Compass CONT`** command.
- If all functions are normal, you can safely discard the old chips.

5-7. Battery Packs

5-7.1. Autonomous Configuration – Alkaline Batteries

The internal alkaline battery pack is built from 16 AA-size alkaline batteries, wired for a nominal capacity of 5.7 Ah at 12.0 V.

- The battery pack is installed in the end of the internal electronics-mounting frame as described in Section 5-2.1.
- Alkaline batteries are not rechargeable and should be properly disposed of when drained.
- See Section 8-2.1 for details on calculating battery life.

To replace the battery pack, use the following steps.

1. Perform all maintenance in a static-free environment.
2. Remove the three screws holding the end cap to the pressure housing.
3. Remove the end cap. Because of the bore seal o-ring, the end cap may be difficult to lift off the pressure housing. If necessary, have one person hold the housing while another rocks the end cap back and forth.
4. Pull the end cap with attached internal electronics and batteries out of the underwater housing, taking care not to catch or pull on the internal wiring.
5. Disconnect the batteries from the internal wiring harness.
6. Remove the three screws holding the mounting plate that secures the battery pack to the internal mounting frame. Remove the used battery pack.
7. Install the new battery pack and secure the mounting plate with the three screws.
8. Connect the batteries to the internal wiring harness.
9. Clean and inspect the o-rings and o-ring surfaces on the end cap. Replace if necessary.
10. Inspect the desiccant pack secured to the electronics mounting hardware. Replace if necessary.
11. If possible, purge the underwater housing with a dry, inert gas (nitrogen, argon).
12. Slide the electronics assembly back into the underwater housing, taking care to avoid catching wires or damaging o-rings or o-ring surfaces.
13. Secure the end cap to the underwater housing using the three screws.

To Avoid Draining of Batteries When System is Not in Use

- Always power the system off before storing the system to prevent draining the batteries.
- All Argonaut-ADV configurations can be powered off by establishing direct communications using *SonTerm* and sending the command **`PowerOff`** (§3-7).

5-7.2. Autonomous Configuration – Rechargeable Batteries (NiCad)

The internal rechargeable battery pack is built from 18 AA-size NiCad batteries, wired for a nominal capacity of 2.0 Ah at 10.8 V.

- The battery pack is installed in the end of the internal electronics-mounting frame as described in Section 5-2.1.
- The battery pack should not normally need user maintenance.
- See Section 8-2.1 for details on calculating battery life.

To charge the batteries, use the following steps.

- **Use only the battery charger supplied by SonTek to ensure reliable operation.**
- Connect the battery charger to the coaxial plug on the power and communication cable.
- Plug the battery charger into an AC outlet.
- A full charge will take about 2 hours.
- The Argonaut-ADV can be operated while the battery is charging.
- The system can be left charging indefinitely; internal electronics control battery charging and prevent over-charging.

To Avoid Draining of Batteries When System is Not in Use

- Always power the system off before storing the system to prevent draining the batteries.
- All Argonaut-ADV configurations can be powered off by establishing direct communications using *SonTerm* and sending the command **`PowerOff`** (§3-7).

5-7.3. Splash-Proof Configuration – Rechargeable Battery (Lead Acid)

The internal rechargeable battery is a 12-V, 2.2-Ah, lead-acid battery.

To charge the batteries, use the following steps.

- **Use only the battery charger supplied by SonTek to ensure reliable operation.**
- Open the vent plug on the back panel of the splash-proof housing.
- Connect the battery charger to the matching coaxial plug on the back panel.
- Plug the battery charger into an AC outlet.
- Check the two LED indicators on the battery charger to make sure the charger is powered on and is charging the battery.
- A full charge will take 6 to 8 hours; watch the LED indicator on the battery charger.
- The charger should not be left connected more than 12 hours to prevent over-charging and battery damage.
- The Argonaut-ADV can be operated while the battery is charging.

To Avoid Draining of Batteries When System is Not in Use

- Always power the system off before storing the system to prevent draining the batteries.
- The Argonaut-ADV splash-proof configuration can be powered off using the switch on the front panel.
- All Argonaut-ADV configurations can be powered off by establishing direct communications using *SonTerm* and sending the command **`PowerOff`** (§3-7).

Section 6. Operational Considerations

6-1. Input Power Supply

6-1.1. Input Power –Underwater Configuration (No Batteries)

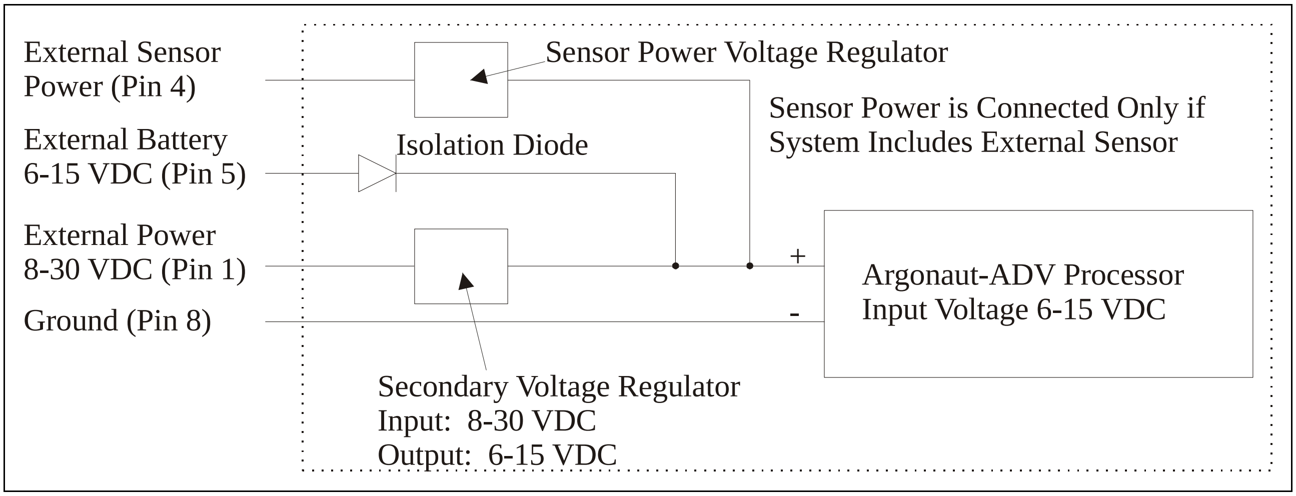

Figure 12 –Input Power Wiring for Underwater Configuration (No Batteries)

The Argonaut-ADV processor operates on 6 to 15 VDC input power.

- If the input voltage is less than 6 VDC, the Argonaut-ADV will not operate reliably.
- An input voltage greater than 15 VDC will seriously damage the electronics.
- The measured input voltage can be accessed from the direct-command interface (§3-11) and the stored data (§3-15 and the *Argonaut-ADV Software Manual*).

When running from externally-supplied power (through Pin 1 of the bulkhead connector):

- The input voltage is passed through a secondary regulator before going to the Argonaut-ADV processor.
- This regulator has a maximum voltage output of 15 VDC; it allows the use of externally supplied power from 8 to 30 VDC.
- The external regulator increases system power consumption (§8-2.1).
- A separate “External Battery” connection bypasses the voltage regulator. This has an input voltage limit of 6 to 15 VDC and offers the lowest possible power consumption.

When running from external battery power (through Pin 5 of the bulkhead connector):

- Battery power is wired directly to the Argonaut-ADV processor.
- Bypassing the voltage regulator provides the lowest possible power consumption.
- **Do not supply more than 15 VDC –** this will seriously damage the Argonaut-ADV.
- The Argonaut-ADV internal recorder uses a solid state EEPROM that is not affected by power loss.

When using a system with external sensors (CTD or YSI):

- Power to the external sensors is supplied through Pin 4 of the bulkhead connector.
- The sensor power specifications vary depending on the sensor used.
- The external sensor power is wired only if the system includes an external sensor.

To Avoid Draining of Batteries When the System is Not in Use

- Always power the system off before storing the system to prevent draining the batteries.
- The Argonaut-ADV is powered off by establishing direct communications using *SonTerm* and sending the command **`PowerOff`** (§3-7).

See the following sections for more information.

- Section 5-5 – Input wiring diagrams
- Section 8-2.1 – Power consumption and battery life

6-1.2. Input Power – Autonomous Configuration (Alkaline Batteries)

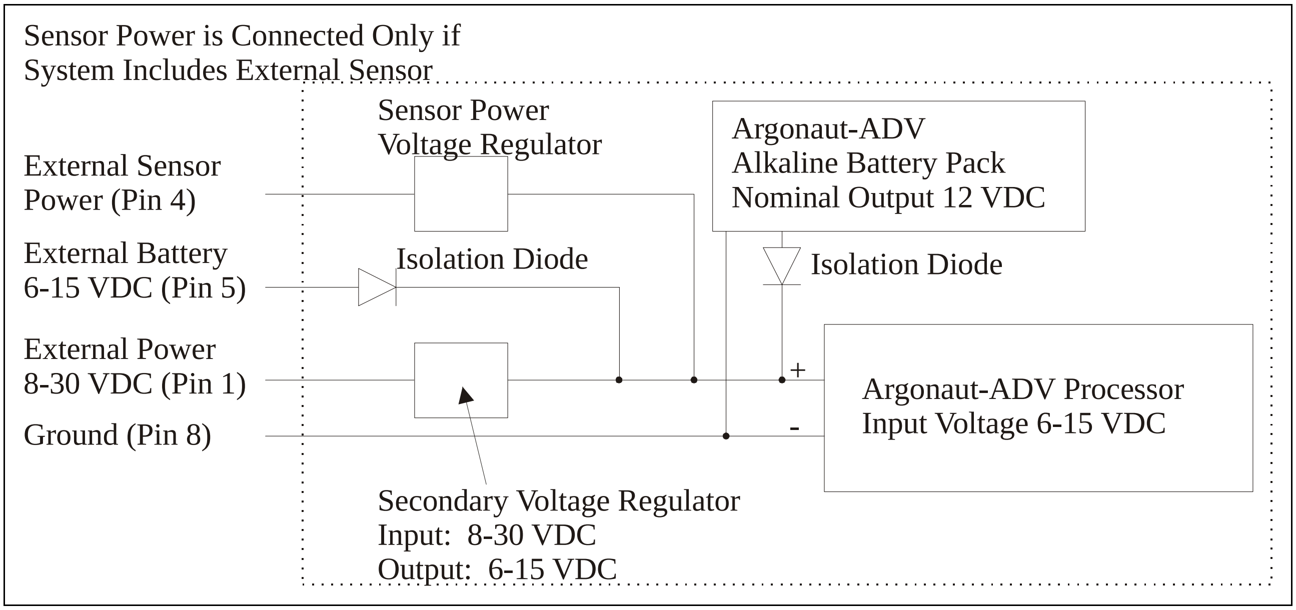

Figure 13 – Input Power Wiring for Autonomous Configuration (Alkaline Batteries)

The Argonaut-ADV processor operates on 6 to 15 VDC input power.

- If the input voltage is less than 6 VDC, the Argonaut-ADV will not operate reliably.
- An input voltage greater than 15 VDC will seriously damage the electronics.
- The measured input voltage can be accessed from the direct-command interface (§3-11) and the stored data (§3-15 and the *Argonaut-ADV Software Manual*).

When running from externally-supplied power (through Pin 1 of the bulkhead connector):

- The input voltage is passed through a secondary regulator before going to the Argonaut-ADV processor.
- This regulator has a maximum voltage output of 15 VDC; it allows the use of externally supplied power from 8 to 30 VDC.
- The external regulator increases system power consumption (§8-2.1).
- A separate "External Battery" connection bypasses the voltage regulator. This has an input voltage limit of 6 to 15 VDC and offers the lowest possible power consumption.

When running from internal battery power:

- Battery power is wired directly to the Argonaut-ADV processor.
- Bypassing the voltage regulator provides the lowest possible power consumption.
- Do not replace the batteries with a configuration that supplies more than 15 VDC.
- Keep track of battery capacity to prevent the loss of data.
- The Argonaut-ADV internal recorder uses a solid state EEPROM that is not affected by power loss.

- When running from external battery power (through Pin 5 of the bulkhead connector):
- External battery power is wired directly to the Argonaut-ADV processor.
- Bypassing the voltage regulator provides the lowest possible power consumption.
- **Do not supply more than 15 VDC –** this will seriously damage the Argonaut-ADV.
- The internal alkaline batteries are isolated from external power using a diode.
- The Argonaut-ADV internal recorder uses a solid state EEPROM that is not affected by power loss.

When using a system with external sensors (CTD or YSI):

- Power to the external sensors is supplied through Pin 4 of the bulkhead connector.
- The sensor power specifications vary depending on the sensor used.
- The external sensor power is wired only if the system includes an external sensor.

To Avoid Draining of Batteries When the System is Not in Use

- Always power the system off before storing the system to prevent draining the batteries.
- The Argonaut-ADV is powered off by establishing direct communications using *SonTerm* and sending the command `PowerOff` (§3-7).

See the following sections for more information.

- Section 5-5 – Input wiring diagrams
- Section 8-2.1 – Power consumption and battery life

6-1.3. Input Power – Autonomous Configuration Rechargeable (NiCad) Batteries

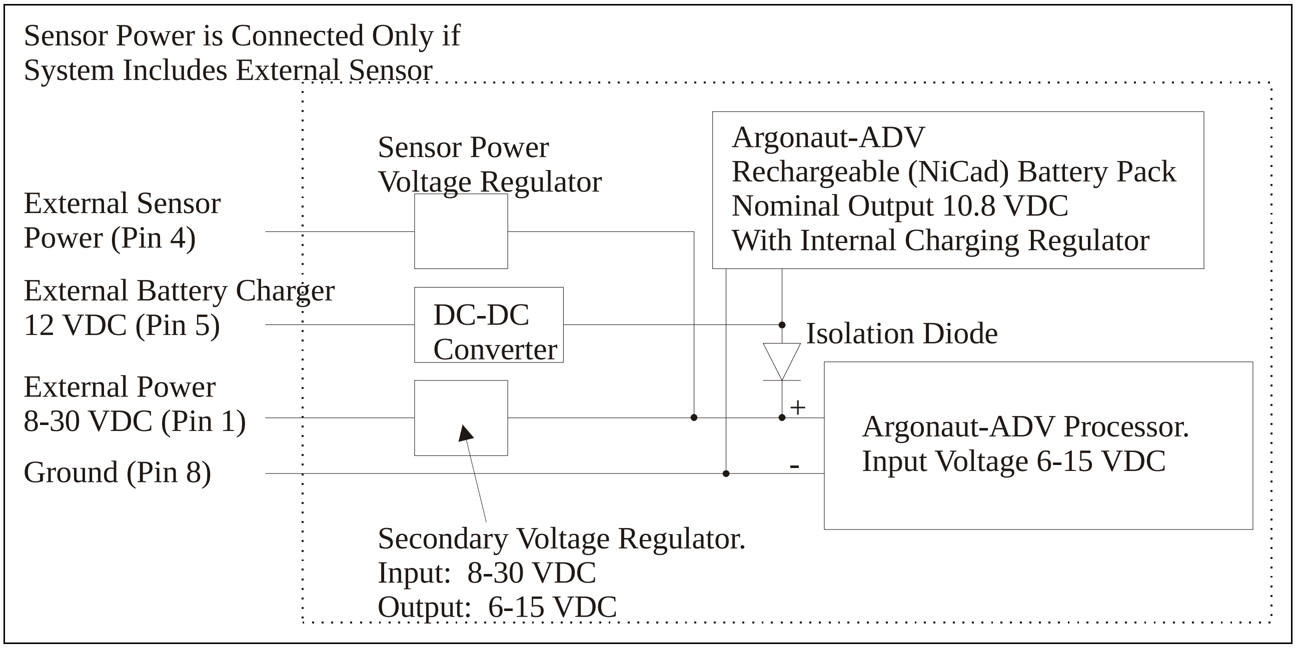

Figure 14 – Input Power Wiring for Autonomous Configuration (Rechargeable Batteries)

The Argonaut-ADV processor operates on 6 to 15 VDC input power.

- If the input voltage is less than 6 VDC, the Argonaut-ADV will not operate reliably.
- An input voltage greater than 15 VDC will seriously damage the electronics.
- The measured input voltage can be accessed from the direct-command interface (§3-11) and the stored data (§3-15 and the *Argonaut-ADV Software Manual*).

When running from externally supplied power (through Pin 1 of the bulkhead connector):

- The input voltage is passed through a secondary regulator before going to the Argonaut-ADV processor.
- This regulator has a maximum voltage output of 15 VDC; it allows the use of externally supplied power from 8 to 30 VDC.
- The external regulator increases system power consumption (§8-2.1).

When running from internal battery power:

- Battery power is wired directly to the Argonaut-ADV processor.
- Bypassing the voltage regulator provides the lowest possible power consumption.
- Do not replace the batteries without consulting SonTek; they are designed to work with a specific recharging system.
- Keep track of battery capacity to prevent the loss of data.
- The Argonaut-ADV internal recorder uses a solid state EEPROM that is not affected by power loss.

When running from the external battery charger (through Pin 5 of the bulkhead connector):

- **Only the SonTek-supplied battery charger should be used through Pin 5 to ensure reliable and safe operation.**
- The battery charger voltage passes through a DC-to-DC converter before supplying the Argonaut-ADV electronics and charging the internal NiCad battery pack.
- The DC-to-DC converter accepts inputs from 10 to 18 VDC and outputs 15 VDC (maximum current 2A). The high current draw is required for charging the batteries.
- The internal battery pack includes circuitry to regulate charging of the batteries. The batteries can be connected to the charger indefinitely without damage.
- The Argonaut-ADV can be operated while the batteries are charging.
- A complete battery charge takes about two hours.
- The DC-to-DC converter increases power consumption (§8-2.1).

When using a system with external sensors (CTD or YSI):

- Power to the external sensors is supplied through Pin 4 of the bulkhead connector.
- The sensor power specifications vary depending on the sensor used.
- The external sensor power is wired only if the system includes an external sensor.

To Avoid Draining of Batteries When the System is Not in Use

- Always power the system off before storing the system to prevent draining the batteries.
- The Argonaut-ADV is powered off by establishing direct communications using *SonTerm* and sending the command **`PowerOff`** (§3-7).

See the following sections for more information.

- Section 5-5 – Input wiring diagrams
- Section 8-2.1 – Power consumption and battery life

6-1.4. Input Power – Splash-Proof Configuration

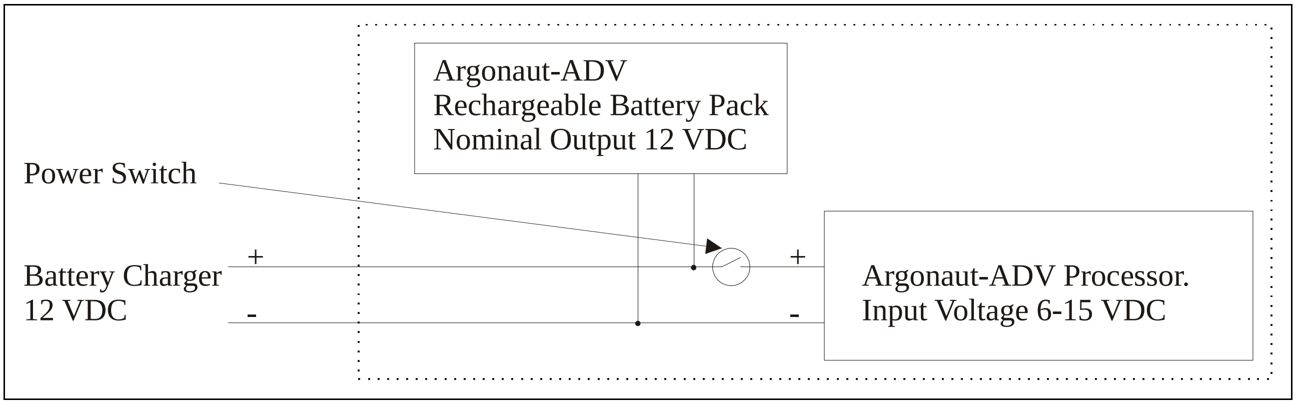

Figure 15 – Input Power Wiring for Splash-Proof Configuration (Rechargeable Battery)

The Argonaut-ADV processor operates on 6 to 15 VDC input power.

- If the input voltage is less than 6 VDC, the Argonaut-ADV will not operate reliably.
- An input voltage greater than 15 VDC can seriously damage the electronics.
- The measured input voltage can be accessed from the direct-command interface (§3-11) and the stored data (§3-15 and the *Argonaut-ADV Software Manual*).

When running from the external battery charger (through the coaxial connector on the back panel of the splash-proof housing):

- **Only the SonTek-supplied battery charger should be used to ensure reliable and safe operation.**
- The Argonaut-ADV can be operated while the batteries are charging.
- A complete battery charge takes 6 to 8 hours.
- To prevent damage to the battery and system electronics, the battery charger should not be left connected more than 12 hours.
- The internal battery can be charged with the front-panel power switch either on or off.

When running from internal battery power:

- Battery power is wired directly to the Argonaut-ADV processor.
- Do not replace the battery with a configuration that supplies more than 15 VDC.
- Keep track of battery capacity to prevent the loss of data.
- The Argonaut-ADV internal recorder uses a solid state EEPROM that is not affected by power loss.

To Avoid Draining of Batteries When the System is Not in Use

- Always power the system off before storing the system to prevent draining the batteries.
- The Argonaut-ADV is powered off by establishing direct communications using *SonTerm* and sending the command **`PowerOff`** (§3-7).
- The Argonaut-ADV splash-proof configuration includes an on/off switch on the front panel that should be turned off when the system is not in use. Note that the batteries can be charged with this switch on or off.

See the following sections for more information.

- Section 5-5 – Input wiring diagrams
- Section 8-2.1 – Power consumption and battery life

6-2. Real-time Clock Backup Battery

The Argonaut-ADV has a backup battery to power the system clock when main power is unavailable.

- The battery is installed on the CPU processor board (§5-3).
- The battery can be expected to last for many years with no maintenance.
- If the backup battery dies, the system clock will reset when main power is disconnected.
- Contact SonTek before attempting to replace the battery.

6-3. Mounting and Installation

The Argonaut-ADV can be mounted in several ways depending on the application. These range from temporary mounts for short-term data collection projects (a few minutes to a few hours), to permanent installations for long-term monitoring stations. For all installations, there are a few common points to keep in mind.

- Clamp the Argonaut-ADV securely (§6-3.1).
- Avoid having excess magnetic material near the instrument (§6-3.2).
- Avoid flow interference that may be caused by the mounting frame (§6-3.3).
- Align the probe perpendicular to the expected flow direction to avoid possible self-generated flow interference (§6-3.3).

6-3.1. Secure Mounting

The Argonaut-ADV is normally supported by circular clamps at two locations along the probe housing. Housing diameter varies with system configuration.

- Underwater / Autonomous configuration: clamp diameter is 9.9 cm (3.90 in) to fit in the recessed grooves for a secure installation
- Splash-Proof configuration (for probe mounting): clamp diameter is 5.1 cm (2.0 in)

Figure 16 – Optional Argonaut-ADV Mounting Clamps

The mounting clamps shown in Figure 16 (for the underwater / autonomous configuration) are available from SonTek.

6-3.2. Magnetic Material

The Argonaut-ADV uses an optional magnetic compass/tilt sensor to report velocity data in Earth coordinates.

- Ferrous metal in the mounting structure near the instrument can affect the accuracy of compass measurements and hence the accuracy of velocity data.
- All mounting fixtures should be designed using non-ferrous metals or plastics.
- Other ferrous metals near the instrument (less than 1-m away) should be minimized.

A compass calibration should be performed before any deployment to account for any ambient magnetic fields. If possible, the calibration should be performed with the Argonaut-ADV mounted exactly as it will be for deployment. See Section 4-4 for details on compass calibration.

6-3.3. Flow Interference

The Argonaut-ADV measures velocity in a small sampling volume (0.25 cm^3; 0.015 in^3) located 10 cm (4 in) from the tip of the probe (see the *Argonaut-ADV Principles of Operation* for details). The placement of the sampling volume relative to other structures in the water must be considered so that the Argonaut-ADV measures velocity free from flow interference.

Structures

- The Argonaut-ADV probe should be installed well clear of any underwater structures, particularly those upstream.
- Consider the size and location of nearby structures, and the probable magnitude and direction of flow, when choosing an installation site.

Probe orientation relative to flow

- The Argonaut-ADV should be oriented so that the axis of the transmit transducer is roughly perpendicular to the expected direction of flow (Figure 17).
- For 3D down-looking probes, this is usually a simple matter since the probe is most commonly looking vertically, down into a region of horizontal flow.
- For side-looking probes (2D and 2D/3D), the probe should be oriented looking across the expected direction of flow (so the X-axis aligns with the expected flow).
- Side-looking probes have been tested and show negligible flow interference with the X-axis as much as 40 to 50° away from the direction of flow.
- If a side-looking probe is oriented directly up or down-stream, the probe will almost certainly see flow interference in the sampling volume.

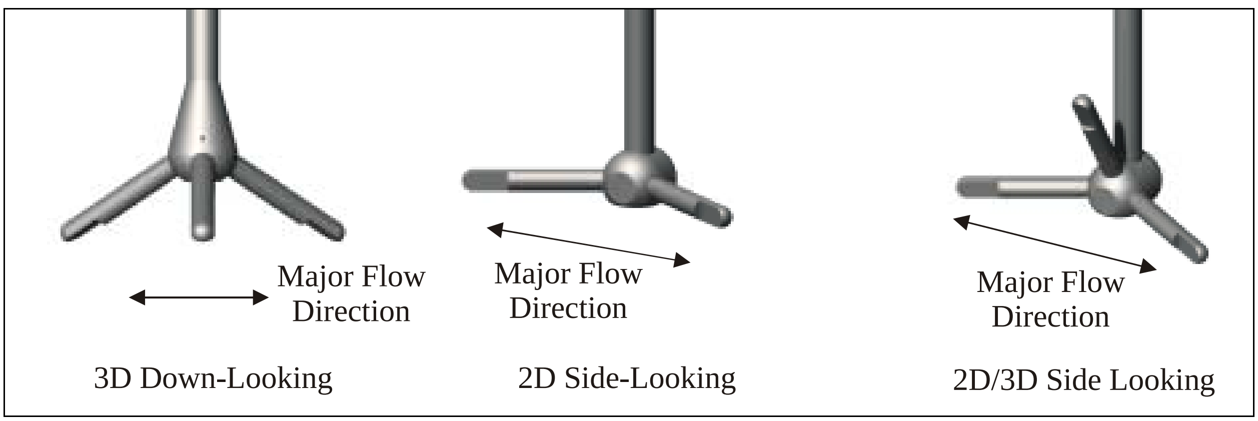

Figure 17 – Preferred Flow Direction to Avoid Flow Interference

6-4. Velocity Data Coordinate System

The Argonaut-ADV supports three coordinate systems for velocity data:

- ENU (East-North-Up, or Earth coordinates)
- XYZ
- Beam

The coordinate system setting is determined in the setup menu of the real-time software (see the *Argonaut-ADV Software Manual*) or using the **`CoordSystem`** command from the direct-command interface (§3-8).

6-4.1. ENU (East-North-Up) coordinate system

The primary advantage of using the internal compass/tilt sensor is the ability to report velocity data in ENU (East/North/Up or Earth) coordinates – independent of the orientation of the Argonaut-ADV.

- When using the ENU coordinate system, velocity is reported in Earth coordinates regardless of the physical orientation of the Argonaut-ADV.
- An Argonaut-ADV mounted with an unknown orientation will provide velocity data consistent with the direction and speed of the water current itself.
- Proper compass operation requires correct installation as described in Section 4-2, and operation within the ±50° tilt limitation.

The translation of velocity data to ENU coordinates is enabled or disabled through commands to the Argonaut-ADV and is transparent to the user.

- Selection of the Earth coordinate system is done using the **`CoordSystem ENU`** command (§3-8) or by a menu item in the data acquisition software (see the *Argonaut-ADV Software Manual*).
- When the compass is installed, heading, pitch, and roll data are stored with each sample if the **`DataFormat`** is set to **`LONG`** (§3-8).
- Compass data are not stored using the **`SHORT`** data format (§3-8).

The Argonaut-ADV performs vector averaging using compass data during each sample.

- Argonaut-ADV velocity data in each sample are averaged using continually updated compass data.
- If the Argonaut-ADV changes orientation during a sample, velocity data will be averaged in Earth coordinates and will not be contaminated by instrument motion.
- Using any other coordinate system for the Argonaut-ADV (beam or XYZ) eliminates this Earth coordinate system vector averaging and can contaminate data if the instrument moves during the course of an averaging interval.

6-4.2. XYZ coordinate system

Using the XYZ coordinate system, velocity measurements are stored using a right-handed Cartesian coordinate system relative to the Argonaut-ADV probe.

- The coordinate system is different depending on whether the system orientation is up or down-looking.
- The coordinate system change is necessary to be able to use compass data to rotate XYZ velocity data to the ENU coordinate system.

The Argonaut-ADV is configured at the factory for up or down-looking operation.

- Down-looking operation is defined as the probe and mounting stem being **below** the Argonaut-ADV processor housing.
- Up-looking operation is defined as the probe and mounting stem being **above** the Argonaut-ADV processor housing.

It is important to understand that up or down-looking orientation from an Argonaut-ADV system level (as described above) is separate from probe construction (which is either down or side looking). For example, a 3D down-looking **probe** can be used with the **system** oriented either up or down-looking.

The XYZ coordinate systems for each probe type and orientation are described in the remainder of this section.

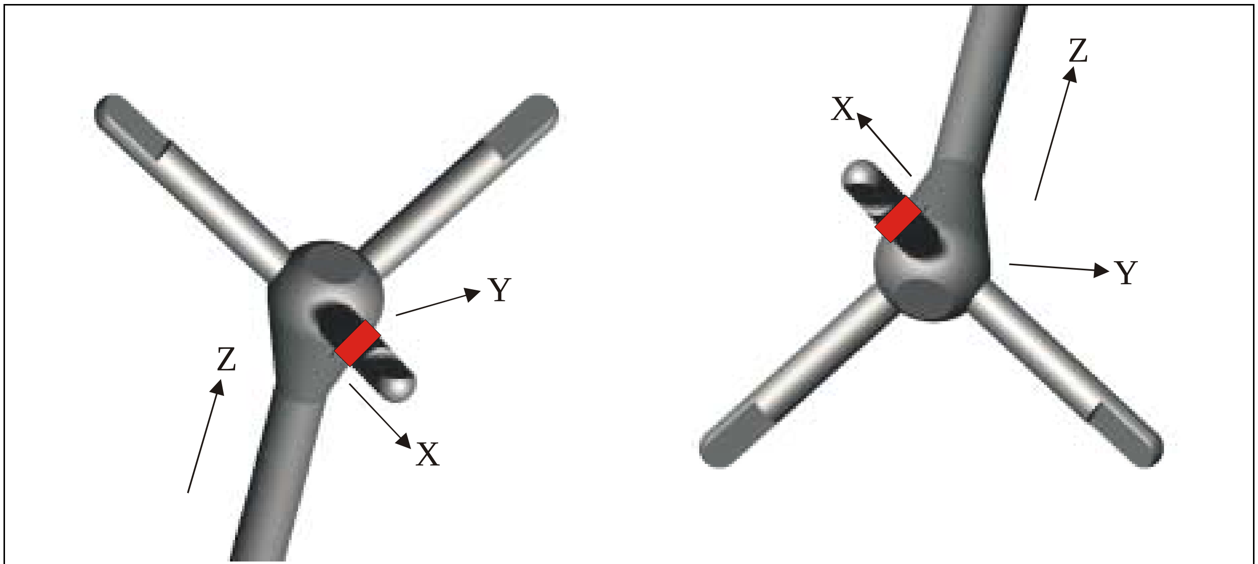

Figure 18 – 3D Down-Looking Probe XYZ Coordinate System

3D Down-Looking Probe – Up-Looking Operation (Figure 18, left)

- The positive Z-axis is defined as vertically up in the direction of the probe's mounting stem (which for this probe is the same as the axis of the transmit transducer).
- The positive X-axis is defined perpendicular to the probe's mounting stem in the direction of receiver arm #1 (which is marked with a red band).
- The positive Y-axis is defined based on the X and Z-axes to make a right-handed coordinate system.

3D Down-Looking Probe – Down-Looking Operation (Figure 18, right)

- The positive Z-axis is defined as vertically up in the direction of the probe's mounting stem (which for this probe is the same as the axis of the transmit transducer).
- The positive X-axis is defined perpendicular to the probe's mounting stem in the direction of receiver arm #1 (which is marked with a red band).
- The positive Y-axis is defined based on the X and Z-axes to make a right-handed coordinate system.

2D Side Looking Probe

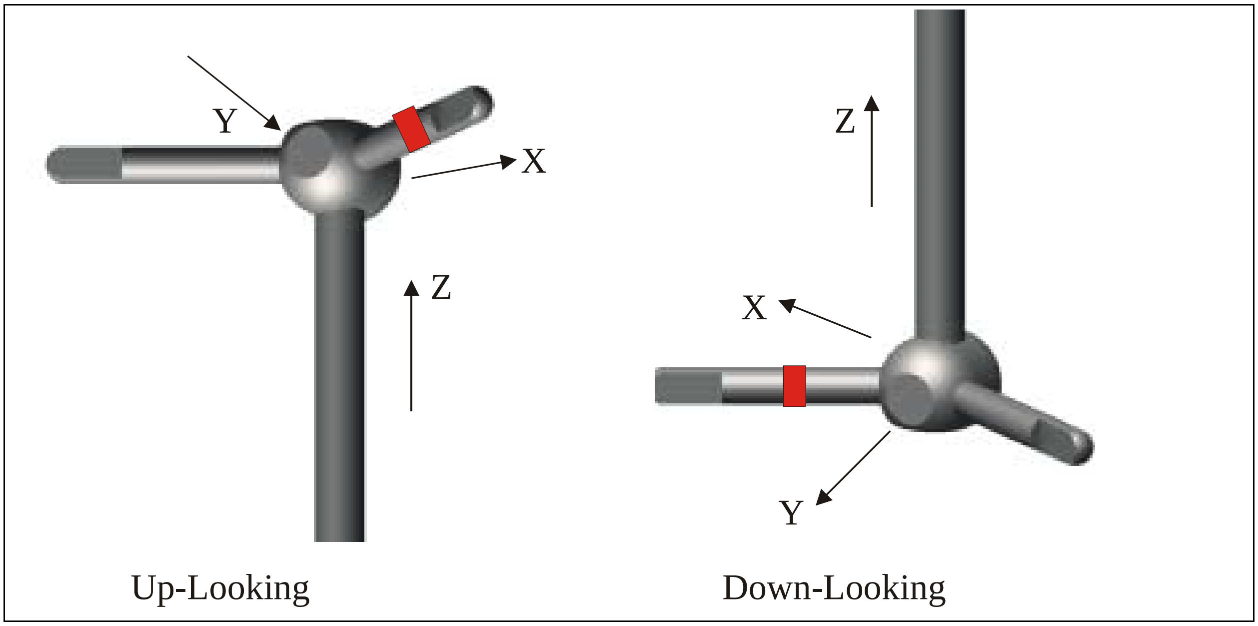

Figure 19 – 2D Side-Looking Probe XYZ Coordinate System

2D Side-Looking Probe – Up-Looking Operation (Figure 19, left)

- The positive Z-axis is defined as vertically up in the direction of the probe's mounting stem.
- The positive X-axis is defined perpendicular to both the probe's mounting stem and the axis of the transmit transducer in the direction of receiver arm #1 (which is marked with a red band).
- The positive Y-axis is defined along the axis of the transmit transducer from the sampling volume towards the transmitter (making a right-handed coordinate system).

2D Side-Looking Probe – Down-Looking Operation (Figure 19, right)

- The positive Z-axis is defined as vertically up in the direction of the probe's mounting stem.
- The positive X-axis is defined perpendicular to both the probe's mounting stem and the axis of the transmit transducer in the direction of receiver arm #1 (which is marked with a red band).
- The positive Y-axis is defined along the axis of the transmit transducer from the transmitter towards the sampling volume (making a right-handed coordinate system).

2D/3D Side-Looking Probe

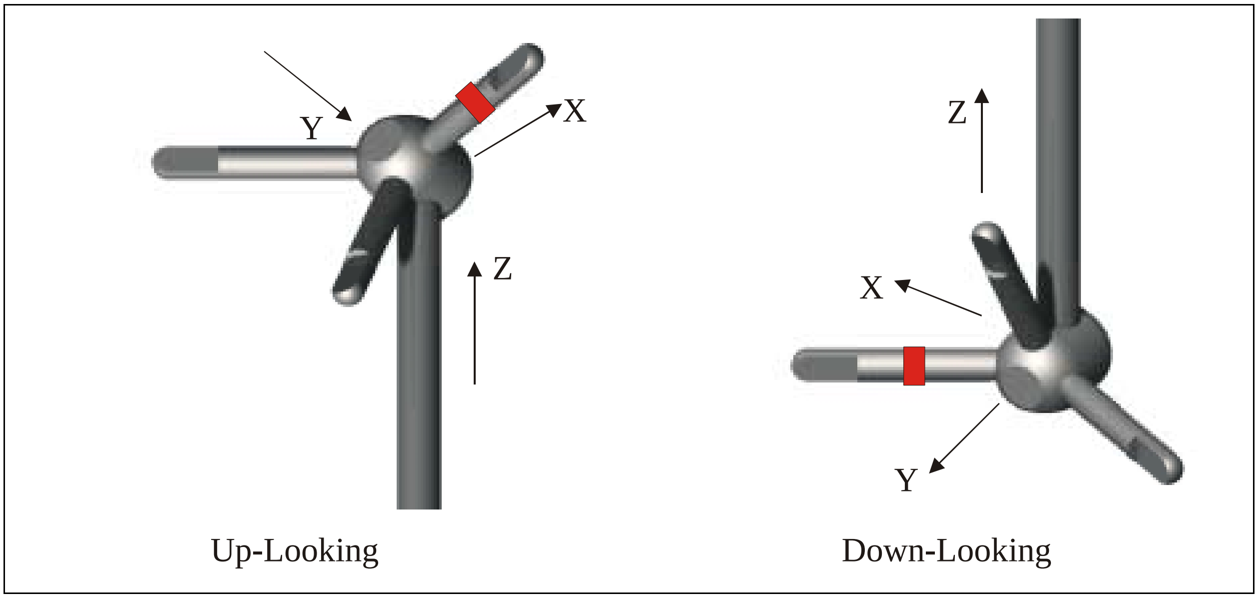

Figure 20 –2D/3D Side-Looking Probe XYZ Coordinate System

2D/3D Side-Looking Probe – Up-Looking Operation (Figure 20, left)

- The positive Z-axis is defined as vertically up in the direction of the probe’s mounting stem.
- The positive X-axis is defined perpendicular to both the probe’s mounting stem and the axis of the transmit transducer in the direction of receiver arm #1 (which is marked with a red band).
- The positive Y-axis is defined along the axis of the transmit transducer from the sampling volume towards the transmitter (making a right-handed coordinate system).

2D/3D Side-Looking Probe – Down-Looking Operation (Figure 20, right)

- The positive Z-axis is defined as vertically up in the direction of the probe’s mounting stem.
- The positive X-axis is defined perpendicular to both the probe’s mounting stem and the axis of the transmit transducer in the direction of receiver arm #1 (which is marked with a red band).
- The positive Y-axis is defined along the axis of the transmit transducer from the transmitter towards the sampling volume (making a right-handed coordinate system).

6-4.3. BEAM coordinate system

The BEAM coordinate system is provided for diagnostic and very specialized purposes only, and is not commonly used.

- Each velocity component is reported as the bistatic velocity for a particular receiver (see the *Argonaut-ADV Principles of Operation*).
- Positive velocities are away from the probe; negative velocities are towards the probe.
- Receiver #1 is marked with a red band on the receiver arm.
- For a 3D down-looking probe, looking down the stem towards the probe, the receivers are numbered clockwise from #1.
- For a 2D side-looking probe, the second receiver arm is #2.
- For a 2D/3D side-looking probe, receiver arm #2 is in the same plane (horizontal) as #1. Receiver arm #3 is positioned vertically in the direction of the mounting stem.

6-5. Serial Communication Protocol

The Argonaut-ADV supports the following serial communication protocols (See Section 3-1 for setup information).

- RS232 – Single system operation with cable lengths to 100 meters (300 feet).
- RS422 – Single system operation with cable lengths to 1500 meters (4500 feet).
- RS485 – Multiple system operation with cable lengths to 1500 meters (4500 feet).
- SDI-12 – Single system operation with cable lengths to 100 meters (300 feet).

The default protocol configuration is RS232. This is the protocol used by the standard serial ports on PC-compatible computers.

- Switching from RS232 to RS422 changes the electrical interface and has no effect on the command interface of the Argonaut-ADV. RS232-to-RS422 converters are available commercially and allow an Argonaut-ADV using RS422 communication to be connected to the RS232 serial port of a PC-compatible computer.
- RS485 uses the same electrical interface as RS422, with a modified command interface to allow multi-system operation. The same RS232-to-RS422 converter is used to run RS485 systems from the RS232 serial port of a PC-compatible computer (using special Argonaut-ADV software for RS485 operation – see Appendix B).
- SDI-12 uses both a modified electrical and command interface. Systems using SDI-12 are also configured to use RS232, since the limited SDI-12 command interface does not allow access to all Argonaut-ADV functions. See Appendix C for details about SDI-12 operation.

One supplier for of RS232-to-RS422 converters is shown below.

B&B Electronics
707 Payton Rd.
Ottawa, IL 61350
USA
Phone (815) 433-5100
Fax (815) 433-5109
Internet www.bb-elec.com
Converter Part # 422COR, Power Supply Part # 422PS

The choice of communication protocol is set at the factory and cannot be changed by the user. Contact SonTek if you have questions about the required serial communication protocol.

6-6. Temperature Sensor

To measure temperature, the Argonaut-ADV uses a thermistor mounted on the inside of the probe head.

- The coupling of the thermistor to the metal probe head gives good response to changes in temperature and ensures the temperature data accurately reflect the water temperature at the area in which velocity measurements are being made.
- The temperature sensor has a specified accuracy of ±0.1°C.
- Temperature data are sampled once per second during the averaging interval, and the mean value is recorded with each sample.

The Argonaut-ADV firmware includes two parameters to calibrate the internal temperature sensor.

- **`TempOffset`** and **`TempScale`** allow a linear calibration to be applied to temperature data.
- For the specified accuracy of the sensor (±0.1° C) no calibration is required; these parameters are set to 0.0 and 1.0 respectively.

The temperature calibration parameters are used as shown below.

True_T = TempOffset + TempScale*Measured_T

where

- True_T = True temperature (°C) output and stored by the Argonaut-ADV
- TempOffset = Temperature offset value (°C); default is 0.0
- TempScale = Temperature scale value (no units); default is 1.0
- Measured_T = Uncorrected temperature value from thermistor

Temperature offset and temperature scale are not normally used, and are not displayed by the software or discussed in Section 3. To access their values from the direct-command interface, use the commands **`TempOffset`** and **`TempScale`** respectively. To set these values based on a user-calibration of the temperature sensor, use the following commands, where X.X and Y.Y are the desired calibration coefficients.

```
TempOffset set X.X
TempScale set Y.Y
```

6-7. Pressure Sensor

If the Argonaut-ADV includes the optional pressure sensor, the sensor is mounted in a recessed hole on the end cap as shown in Figure 1 (at the beginning of this manual).

- The sensor is protected by a retaining plug that screws into the end cap.
- If you suspect problems, please contact SonTek before trying to access the sensor.

Two types of pressure sensors are available.

- A strain gage pressure sensor is available in full-scale ranges from 10 to 60 meters, and provides an accuracy of 0.1% of the range. The strain gage sensor outputs data as an analog voltage.
- A resonant pressure transducer (RPT) sensor is available in a 20-m full-scale range, and provides an accuracy of 0.01% of the range. The RPT sensor outputs data as a frequency signal.
- Operation of the two types of sensors is controlled automatically by the Argonaut-ADV; the user interface is identical.
- Strain gage sensor data are sampled by the Argonaut-ADV electronics using a 12-bit A/D converter. Data are converted to a 2-byte integer, scaling the A/D counts by 16 (giving a total count range of 0-65520, with a step size of 16 counts).
- RPT sensor data is sampled using a frequency counter and stored as a 2-byte integer (total range 0-65535).

Mean and standard deviation of pressure are recorded with each sample.

- Pressure data are stored in counts that must be converted to physical units (decibar) using three calibration constants.
- The pressure calibration constants are measured at the factory and included with each system (in memory).
- The constants are stored in each data file and can be accessed from the Argonaut-ADV direct-command interface.
- Pressure in counts is converted to decibar using the following formula.

$$\text{dBar} = \text{PressOffset} + (\text{PressScale} \times \text{Counts}) + (\text{PressScale\_2} \times (\text{Counts}^2))$$

```
dBar           = measured pressure (decibar)
PressOffset    = offset calibration constant (decibar)
PressScale     = 1st order calibration constant (decibar/count)
PressScale_2   = 2nd order calibration constant (decibar /count²)
Counts         = measured pressure (counts)
```

When using the SonTek data conversion software to access Argonaut-ADV data files, the conversion from counts to decibars is done automatically.

If accessing the binary data files directly, you will need to convert the pressure counts to physical units (decibars). The pressure calibration constants (PressOffset, PressScale, and PressScale_2) can be accessed three ways.

- Through the direct-command interface (§3-11)
- From the data conversion software *.CTL file (see the *Argonaut-ADV Software Manual*)
- Directly from the binary data file

In the first two methods, **`PressOffset`** and **`PressScale`** are output with the units shown above and can be used directly in the formula above. **`PressScale_2`** is output with units of 10^{-12} decibar/count^2 and must be multiplied by (10^{-12}) before using in the above formula.

When using the binary data directly, each constant is stored as a long integer and must be converted to the appropriate units before using. **`PressOffset`** is stored in units of microbar and must be multiplied by 10^{-5}. **`PressScale`** is stored with units of (nanoBar / count) and must be multiplied by 10^{-8}. **`PressScale_2`** is output with units of (pico-decibar/count^2) and must be multiplied by 10^{-12}. See Appendix B for details on the binary data format.

6-7.1. Modifying Pressure Offset Value for Atmospheric Pressure Variations

The pressure sensors used by the Argonaut-ADV are not vented to the atmosphere.

- The pressure data will change with variations in atmospheric pressure.
- Large atmospheric variations can cause pressure variations as large as 0.1 to 0.2 decibars. This is equivalent to 10 to 20 cm (4 to 8 in) of water level.
- If an external measure of barometric pressure is available, this can be used to correct pressure data in postprocessing.

The factory calibration is set to give a pressure of zero at atmospheric pressure at the time / place of calibration. When deploying the instrument, it may be desired to reset the pressure offset to give zero pressure at the time / place of deployment. This can be done using the following steps.

- Establish direct communication with the Argonaut-ADV using *SonTerm*.
- Send a **`BREAK`** to establish communication.
- Send **`Show Conf`**, and take note of the **`PressOffset`** value. As an example, let us assume that value is 0.5400 decibars.
- Send **`Sensor CONT`**. This will start a continuous output of temperature, pressure, and battery voltage data. After 5 to 10 samples, press any key to stop output. Take note of the typical pressure value. For this example, let us assume it is -0.230.
- Calculate the new pressure offset to set the pressure value in air to zero.

```
New_PressOffset = Old_PressOffset – Pressure_Value
(i.e. New_PressOffset = 0.5400 – (-0.230) = 0.7700)
```

- Set the new value by entering **`PressOffset Set 0.7700`** (for this example).
- Send **`Show Conf`** to verify the **`PressOffset`** value.
- Send **`Sensor Cont`** to verify that the pressure data is close to zero (should be less than 0.05). Press any key to stop the output of sensor data.

6-8. Routine Maintenance

Under normal conditions, the Argonaut-ADV requires little maintenance for years of reliable performance. Normal wear does not change instrument performance, and the Argonaut-ADV never requires recalibration for velocity data (unless the probe is physically damaged). This section discusses suggested routine maintenance procedures.

6-8.1. Regular Diagnostic Procedures – ArgCheck

The Argonaut-ADV software includes a diagnostic program called *ArgCheck* (Windows software) or *ArgADVCk* (DOS software). Use and interpretation of the program is described in the *Argonaut-ADV Software Manual*.

We recommend running this program on a regular basis, at the very least before every deployment. The program can verify all aspects of Argonaut-ADV operation.

6-8.2. Cleaning the Transducers

Biological growth on the transducers does not affect velocity measurements, but can decrease acoustic signal strength and potentially increase noise in velocity data when operating in clear water.

- Periodic cleaning of the Argonaut-ADV transducers may be needed to maintain optimal performance in areas of high biological activity.
- Argonaut-ADV transducers are encapsulated in an epoxy that is impervious to damage from barnacles or other types of growth.
- To remove growth, simply clean with a stiff brush. The transducer epoxy is very durable and cannot be easily damaged except by direct impact.
- We recommend coating the transducers with anti-fouling paint for deployments in regions of high biological activity (§6-9).

6-8.3. Cable Maintenance

The underwater cables used with the Argonaut-ADV are often the most vulnerable part of the system.

- All standard SonTek cables use a durable polyurethane jacket that provides excellent long-term wear and abrasion resistance.
- Any underwater cable is susceptible to damage, so reasonable precautions should be taken.
- Inspect all Argonaut-ADV cables and connectors for damage on a regular basis; replace if necessary.
- In areas where cables may be subject to physical damage, additional protection can be added to the cable. One common method is to split a garden hose and wrap it around the cable.

6-8.4. O-rings

All Argonaut-ADV housings use a dual (redundant) o-ring seal.

- All SonTek o-ring seals are designed for full-ocean depth pressures, even if the housings and transducers have lower pressure ratings.
- The o-rings will provide faultless performance as long as care is taken whenever the system is opened.
- Whenever the housing is opened, clean and inspect all o-rings and o-ring surfaces; replace o-rings when necessary. Even small cuts or small bits of debris can create a leakage path.
- While the system is open, protect o-ring surfaces from scratches or other damage.
- Spare o-rings are included in the Argonaut-ADV tool kit.
- Contact SonTek if additional o-rings are needed.

6-8.5. Condensation in Argonaut-ADV Housings

Moisture in the air can potentially damage Argonaut-ADV electronics if allowed to condense inside the housing.

- All underwater housings include desiccant to absorb moisture.
- Whenever opening the Argonaut-ADV housing, take care to minimize the exposure of the desiccant to humid air.
- If you suspect the desiccant has been saturated, replace the packet before closing the housing (spare desiccant is included in the Argonaut-ADV tool kit).
- When possible, purge the housing with a dry, inert gas (Nitrogen, Argon) before closing.

6-9. Protection from Biological Fouling

The Argonaut-ADV has excellent resistance to biological fouling and can operate reliably even with biological growth on the transducers.

- Biological growth causes a loss in signal strength, but does not affect velocity measurements.
- Both the Argonaut-ADV transducers and the underwater housings can be coated with commercial anti-fouling paints to prevent biological growth.
- Thick layers of anti-fouling paint on the transducers will decrease acoustic signal strength and could potentially introduce seeding requirements (§6-10).
- For most applications, the loss of signal strength caused by anti-fouling paint does not have a significant effect on instrument performance.

Within the United States, we recommend using an anti-fouling paint called Interlux Tri-Lux II. This paint contains a biocide, a copper derivative, which allows its use on all metals; see contact information for the manufacturer below.

Courtaulds Coatings	Phone: (908) 686-1300
2270 Morris Avenue	Fax: (908) 686-8545
Union, NJ 07083 USA	Internet: www.yachtpaint.com

Normal anti-fouling paints, which use cuprous oxide based biocides, cannot be used on some metals as they cause galvanic corrosion. Outside the United States, anti-fouling paints containing TBT can be used on metal systems with a suitable primer. On plastic parts, any type of anti-fouling paint can be used.

- When painting metal parts, a suitable conversion layer must be applied to the metal for adhesion and to isolate the metal from the anti-fouling paint.
- We suggest Interlux 360 Underwater Metal Primer (same manufacturer as above).
- The primer should be applied to all exposed metal surfaces **except** sacrificial zinc anodes.
- Apply the anti-fouling paint to all surfaces of the instrument that require protection **except** sacrificial zinc anodes.
- If anti-fouling protection is desired for some portion of the cable, the paint can be applied directly to the polyurethane jacket without primer.

Follow the instructions on the paint container with the following exceptions.

- Apply only one coat of anti-fouling paint to the transducers. Each layer causes some loss in signal strength and multiple layers can potentially affect system performance. Ensure that the paint has a smooth, even surface with no air bubbles.
- Do not paint the sacrificial zinc anode. Doing so will remove all corrosion protection.

6-10. Seeding

If Argonaut-ADV velocity data appears "noisy", the most common cause is a lack of scattering material in the water.

- See the *Argonaut-ADV Principles of Operation* for details about how/why the Argonaut-ADV uses scattering material for velocity measurements.
- A lack of scattering material can increase the instrument-generated noise in velocity data. If insufficient scattering material is present, the Argonaut-ADV will not be able to accurately make velocity measurements.
- In most laboratory applications, and almost all field applications, there is sufficient scattering material naturally present for Argonaut-ADV operation.
- Large laboratory basins often have insufficient natural scattering material.
- The diagnostic software *ArgCheck* (Windows version) or *ArgADVCk* (DOS version) is used to evaluate the operational environment (see the *Argonaut-ADV Software Manual*).
- A lack of scattering material can be remedied by adding seeding.

An ideal seeding material should have the following qualities.

- Neutrally buoyant (to remain in suspension for a long period of time)
- Mean particle diameter of 10-20 µm (for peak sensitivity of the acoustic signal)
- Inexpensive, readily available, with no adverse effects on the operating environment

The best seeding material we have located (from an acoustics point of view) are hollow glass spheres with a mean diameter of approximately 10 µm and a mean density close to that of water.

- A small bottle of this material (mixed with water) is included with the Argonaut-ADV.
- A small amount of this material is sufficient for testing in small tanks.
- Larger quantities can be purchased from the manufacturer at the address below.

Potters Industries	Phone: (610) 651-4700
Valley Forge, PA USA	Internet: www.pottersbeads.com
Part name: Potters Sphericel	

For most applications, a more practical seeding material is lime or pulverized limestone (the chalk commonly used on athletic fields).

- Large bags are inexpensive and readily available from most hardware stores.
- While not perfect, the acoustic performance is sufficient for most applications.
- A variety of distribution arrangements can be used to seed even very large tanks.
- A minor note of caution: repeated addition will gradually increase the pH in a tank (in addition to creating a layer of lime/limestone on the bottom of the tank).

6-11. Troubleshooting

This section provides suggestions for diagnosing problems with the Argonaut-ADV. If you have trouble finding the source of a problem, please contact SonTek.

6-11.1. Velocity Data Appears Noisy or Unreasonable

If the velocity data from the Argonaut-ADV does not appear reasonable, the following list may be helpful in establishing the source of the problem.

- Lack of scattering material in the water is the most common problem (particularly in large laboratory tanks). See Section 6-10 and the *Argonaut-ADV Principles of Operation* for seeding requirements.
- Run *ArgCheck* (Windows version) or *ArgADVCk* (DOS version) as described in the *Argonaut-ADV Software Manual*. This will address all aspects of Argonaut-ADV operation, especially signal strength (scattering/seeding issues) and probe operation.
- Verify the velocity range setting is appropriate for the operating environment (see *Argonaut-ADV Principles of Operation*).
- Verify the probe is not fouled with debris.
- Verify the Argonaut-ADV mounting is stable and that instrument motion is not causing noise in the velocity data.
- Look at the compass/tilt sensor data (if installed). Look for large tilt values that may indicate the Argonaut-ADV is not near vertical (or is even upside down). Look at how compass/tilt data changes with time to see if the deployment package is moving.
- Consider any possible influences of the deployment environment, particularly flow interference from nearby underwater structures (§6-3.3).
- Consider the orientation of the probe with respect to the flow direction to be sure the probe is not causing flow interference in the sampling volume (§6-3.3).

6-11.2. Cannot Communicate with the Argonaut-ADV

If you are unable to establish communications with the Argonaut-ADV, the following list may be helpful in identifying the problem.

- Verify all cables to the Argonaut-ADV are securely connected.
- Verify the power supply is providing 6 to 15 VDC to the processor (or 6 to 30 VDC through the external supply, see Section 6-1). When power is first connected, the Argonaut-ADV should wake up and enter the mode last used (i.e., command, data acquisition, or deployment mode – see Section 3-2). Measure the input current when power is applied to see if the system is drawing any power. Try using an alternative power source if possible.
- Verify the computer serial port is functioning correctly. Try using a different computer.
- Verify the baud rate, serial port, and other communication parameters match Argonaut-ADV settings (§3-1 and the *Argonaut-ADV Software Manual*).
- If the Argonaut-ADV software is unable to establish communications, try direct communications using a terminal emulator (*SonTerm*). When power is applied, see if the Argonaut-ADV will respond to a **BREAK**.

6-11.3. Compass/Tilt Sensor

If you suspect a problem with the Argonaut-ADV compass/tilt sensor, try the following.

- Follow the procedure outlined in Section 4-1 for a basic compass function test.
- If you see problems with heading, perform a compass calibration and retest compass function. A bad compass calibration can cause a major distortion to the heading data.
- Be sure the Argonaut-ADV is oriented properly based on compass installation (up or down-looking – see Section 4-2).

6-11.4. Cannot Retrieve Data from Internal Recorder

The following items are common causes of communication errors when retrieving data from the internal recorder (using the *SonRec* software).

- The data-extraction baud rate is too high for reliable operation (by default it runs at 115200). The maximum baud rate is a function of the length and quality of cables, the computer, and the operating environment (external noise). Run *SonRec* using a lower extraction rate (see the *Argonaut-ADV Software Manual*).
- Some computers have poor quality serial ports and are unable to retrieve large amounts of data at high baud rates. Try using another computer or lower extraction baud rate.
- Older computers running Windows do not always work reliably with DOS software. If you are having problem using the DOS version of *SonRec*, try using the Windows version (*SonUtils|SonRecW*).
- If you are still unable to retrieve data from the internal recorder using *SonRec*, establish direct communications with the Argonaut-ADV, and use the recorder commands to access data files directly (§3-10). Check that the file size and number of samples is reasonable. Download a portion of the data manually to verify that all data are present.

6-11.5. Missing data from autonomous deployment

The Argonaut-ADV internal recorder was designed for extremely high reliability; recorder failures are very rare.

- The only data losses that have occurred are because of problems with the Argonaut-ADV power supply.
- If you have a deployment that appears to be missing data, look at the battery voltage recorded with each sample. Check that these values are reasonable based on the type of power supply used and the length of the deployment.
- If you cannot determine what happened, please contact SonTek.

Section 7. Real-Time Deployment

Real-time deployments are applications where the Argonaut-ADV uses an external power supply (battery or DC input) and data is recorded using an external computer or data logger.

7-1. Selecting Operating Parameters

The choice of Argonaut-ADV operating parameters depends on the nature of the deployment and the goal of the study. Guidelines for the most important parameters are given below.

7-1.1. System Parameters

See Section 3-7 for details about these parameters.

Parameter	Comments
Date	Set the system clock before deployment (done automatically by the SonTek real-time software).
Time	Set the system clock before deployment (done automatically by the SonTek real-time software).
AutoSleep	This is normally **`ON`** unless run-time commands are being used (§3-14). Note that turning this **`OFF`** will increase power consumption, as the system will not enter a low power mode between pings and samples.
OutMode	This is normally **`AUTO`** unless run-time commands are being used (§3-14). Note that setting this to **`POLLED`** means that data will not be output over the serial port unless requested by an external data logger.
OutFormat	This is set based on the requirements of the computer or data logger. See Section 3-15 for details about each format. • **`BINARY`** is used by SonTek real-time software and is the most compact storage format. • **`ASCII`** outputs data in a tab-delimited text format using the internal units system of the Argonaut-ADV. • **`SEABIRD`** is a specialized format for use with inductive modems. • **`METRIC`** and **`ENGLISH`** are tab-delimited text formats using the specified units system in standard units. These are most commonly used with SDI-12 data loggers.
Recorder	If set to **`ON`**, the internal recorder can be used for backup data storage. If set to **`OFF`**, data is output only over the serial port and is not stored internally. This setting has no effect on power consumption or system performance.
RecMode	This is not currently enabled and should be set to **`NORMAL`**.

7-1.2. Setup and Deployment Parameters

See sections 3-8 and 3-9 for details about these parameters.

Parameter	Comments
Temp	The default temperature setting should not matter, since most deployments will use **`TempMode MEASURED`**.
Sal	The default salinity should be as accurate as possible. As long as salinity is accurate to ~2 ppt, sound speed variations will have no significant effect on the accuracy of velocity data.
TempMode	This should be **`MEASURED`** for all but specialized applications (data from the temperature sensor are used for sound speed calculations).
CoordSystem	If the system includes a compass/tilt sensor, this is normally set to **`ENU`**. It is set to **`XYZ`** for systems without the compass/tilt sensor.
VelRange	This is normally set to **`AUTO`** to give the best performance over the widest velocity range. The pre-set velocity ranges are used only for severely power-limited applications (§8-2). If using pre-set velocity ranges, choose the lowest range setting that you are confident the velocities will not exceed (see the *Argonaut-ADV Principles of Operation*). The SonTek real-time software forces velocity range to **`AUTO`**.
DataFormat	This setting depends on the data logger or computer used. • When possible, we recommend using the **`LONG`** format for access to all parameters and diagnostic data. • The SonTek real-time software sets data format to **`LONG`**. • SDI-12 data loggers normally use the **`SHORT`** format as they accept a limited number of parameters (see Appendix C).
StartDate / StartTime	These parameters are not used with real-time data collection.
See Section 1-3 for details on sampling parameters listed below.	
AvgInterval	Averaging time is typically based on real variations in water velocity: what time is needed to obtain a good mean-current value.
SampleInterval	For real-time data collection, the system normally (but not always) operates continuously with **`SampleInterval`** set to the same value as **`AvgInterval`**.
BurstMode	Burst sampling is not used with real-time data collection.
BurstInterval	Burst sampling is not used with real-time data collection.
SamplesPerBurst	Burst sampling is not used with real-time data collection.

7-2. Power Consumption and Data Storage Requirements

7-2.1. Power Consumption

Power Consumption

- With the **`AUTO`** velocity range, the Argonaut-ADV consumes 0.5 W.
- Using a pre-set velocity range, the Argonaut-ADV consumes 0.25 W.
- The **`AUTO`** velocity range is recommended for the best performance except for severely power-limited applications (see the *Argonaut-ADV Principles of Operation*).
- Power consumption for the optional CTD must be accounted for (if installed). It is estimated by the equation below. For example, using an **`AvgInterval`** of 60 seconds, the CTD power will be 0.08 W (giving total power consumption of 0.58 W using the **`AUTO`** velocity range).

  CTD_Power (Watts) = 5 / AvgInterval (seconds)
- Power consumption for the optional YSI must be accounted for (if installed). It is estimated by the equation below. For example, using an **`AvgInterval`** of 300 seconds, the YSI power will be 0.17 W (giving total power consumption of 0.67 W using the **`AUTO`** velocity range). Because of its higher power consumption, the YSI is normally only used with slower sampling rates or with long averaging times.

  YSI_Power (Watts) = 50 / AvgInterval (seconds)
- The total power consumption is the sum of the Argonaut-ADV power consumption with any optional sensors (CTD or YSI).
- **IMPORTANT:** These power consumption values assume power is fed through the direct battery power connection to the Argonaut-ADV processor rather than through the secondary voltage regulator or the DC-to-DC converter (for systems with rechargeable batteries - see input power specifications in §6-1). Using the secondary voltage regulator or DC-to-DC converter increases power consumption by a factor of two during data collection and during sleep mode (from <1 mW to 0.5 W).

Battery Pack Capacity

- SonTek recommends using 80% of the nominal battery capacity to allow for temperature variations (nominal capacities are at 20°C) and a reasonable safety margin.
- The Argonaut-ADV Autonomous alkaline battery pack outputs 12.0 V with a nominal capacity of 5.7 Ah. Using 80% of nominal capacity gives 55 Wh of energy.
- The Argonaut-ADV Autonomous rechargeable (NiCad) battery pack outputs 10.8 V with a nominal capacity of 2.0 Ah. Using 80% of nominal capacity gives 17 Wh of energy.
- The Argonaut-ADV Splash-Proof rechargeable battery pack outputs 12.0 V with a nominal capacity of 2.2 Ah. Using 80% of nominal capacity gives 21 Wh of energy.
- User-supplied batteries and power systems will have widely varying capacities and must be calculated on a case-by-case basis.

Duty Cycle

- Duty cycle is the percentage of time the Argonaut-ADV is actively collecting data.
- When not collecting data, the Argonaut-ADV enters a low-power state (< 1 mW). Note power consumption in the low-power state is negligible only if using the direct battery power connection (see input power specifications, §6-1).
- When not using burst sampling, duty cycle is calculated as:
  (AvgInterval / SampleInterval)
- When using burst sampling, duty cycle is calculated as:
  ((AvgInterval * SamplesPerBurst) / BurstInterval)
- Battery life scales directly with duty cycle. For example, a duty cycle of 0.2 (20%) increases battery life by a factor of five.
- See Section 1-3 for a description of sampling strategies and duty cycle calculation.

Battery Life Calculation

- Battery life is calculated as follows.
  Battery_life = Battery_capacity / Power_consumption / Duty_cycle

Example 1: An Autonomous Argonaut-ADV with alkaline battery pack (no CTD or YSI) will be deployed using the **`AUTO`** velocity range, **`AvgInterval`** 120 seconds, **`SampleInterval`** 600 seconds, no burst sampling.

- Battery capacity is 55 Wh, power consumption is 0.5 W, which gives power for 110 hours (4.6 days) of continuous operation.
- Duty cycle is (120 / 300) = 0.2. Total battery life is therefore (4.6 / 0.2) = 23 days.

Example 2: An Autonomous Argonaut-ADV with rechargeable (NiCad) battery pack and external CTD will be deployed using the **`AUTO`** velocity range, **`AvgInterval`** 120 seconds, **`SampleInterval`** 120 seconds, no burst sampling.

- Battery capacity is 17 Wh; power consumption is 0.54 W, which gives power for 31.5 hours (1.3 days) of continuous operation.
- Duty cycle is (120 / 120) = 1.0. Total battery life is 23 days.

To Avoid Draining of Batteries When the System is Not in Use

- Always power the system off before storing the system to prevent draining the batteries.
- The Argonaut-ADV splash-proof configuration can be powered off using the switch on the front panel.
- All Argonaut-ADV configurations can be powered off by establishing direct communications using *SonTerm* and sending the command **`PowerOff`** (§3-7).

7-2.2. Data Storage Requirements

Data storage requirements depend on the output format and data format settings.

- Binary data files recorded by the SonTek real-time software use the same format as the internal recorder (storage requirements described in §8-2.2).
- The number of bytes per sample for other data formats depends upon the output format, data format and what (if any) external sensors are installed. The number of transmitted characters for all combinations is shown in the table below.
- Data storage with the external YSI sensor will vary with sensor configuration; contact SonTek for details.
- For details on SDI-12 output storage requirements, see Appendix C.

All values in the table below represent the total output string length, including the <CR><LF> sent at the end of each line.

Output Format	Data Format	CTD Installed	Output Record Length per Sample
ASCII	Short	No	74
		Yes	114
	Long	No	133
		Yes	173
English	Short	No	79
		Yes	119
	Long	No	158
		Yes	198
Metric	Short	No	79
		Yes	119
	Long	No	157
		Yes	197
SeaBird	Short / Long	Yes / No	77

Depending on the type of data logger, you may have the ability to record only a portion of each output sample record if it is necessary to reduce data storage requirements.

7-3. Starting a Real-Time Deployment

The start-up procedure for real-time data collection depends on what type of data logger and software are being used.

SonTek Real-Time Data Collection Software

- Operation of the real-time data collection software is described in the *Argonaut-ADV Software Manual*.

SDI-12 Data Logger

- Operation using an SDI-12 data logger is described in Appendix C.
- See the *Argonaut-ADV Software Manual* for a description of deployment software that can be used for SDI-12 deployments.

Section 8. Autonomous Deployment

Autonomous deployments are applications where the Argonaut-ADV is operating from battery power (either internal or external) and storing data on the internal recorder.

8-1. Selecting Operating Parameters

The choice of Argonaut-ADV operating parameters depends upon the nature of the deployment and the goal of the study. Guidelines for the most important parameters are given below.

8-1.1. System parameters

See Section 3-7 for details about these parameters.

Parameter	Comments
Date	Set the system clock before deployment.
Time	Set the system clock before deployment.
AutoSleep	This should be set **ON** for autonomous deployments. The **Deploy** command automatically causes the system to enter a low-power state between samples regardless of the setting of this parameter (it forces **AutoSleep ON**).
OutMode	This is not typically important for autonomous deployments, since it affects only data output over the serial port and not data stored on the internal recorder. If storing data with an external data logger, set the parameter (**AUTO**/**POLLED**) as required by the data logger.
OutFormat	This is not typically important for autonomous deployments, since it affects only data output over the serial port and not data stored to the internal recorder. If storing data with an external data logger, set the parameter (**ASCII** / **BINARY** / **SEABIRD** / **METRIC** / **ENGLISH**) as required by the data logger.
Recorder	This should be set **ON** for autonomous deployments. The **Deploy** command automatically stores data to the internal recorder regardless of the setting of this parameter (it forces the recorder **ON**).
RecMode	This is not currently enabled and should be set to **NORMAL**.

8-1.2. Setup and Deployment Parameters

See sections 3-8 and 3-9 for details about these parameters.

Parameter	Comments
Temp	The default temperature setting should not matter, since most deployments will use **`TempMode MEASURED`**.
Sal	The default salinity should be as accurate as possible. As long as salinity is accurate to ~2 ppt, sound speed variations will have no significant effect on the accuracy of velocity data.
TempMode	This should be **`MEASURED`** for all but specialized applications (data from the temperature sensor are used for sound speed calculations).
CoordSystem	If the system includes a compass/tilt sensor, this is normally set to **`ENU`**. It is set to **`XYZ`** for systems without the compass/tilt sensor.
VelRange	This is normally set to **`AUTO`** to give the best performance over the widest velocity range. The pre-set velocity ranges are used only for power-limited applications (§8-2). If using pre-set velocity ranges, choose the lowest range setting that you are confident the velocities will not exceed (see the *Argonaut-ADV Principles of Operation*).
DataFormat	This is set to **`LONG`** to store all diagnostic data except for memory-limited applications. See Section 8-2 to calculate data storage requirements. When possible, we recommend using the **`LONG`** format to have the greatest flexibility in data analysis.
StartDate / StartTime	These parameters determine the precise start date/time of the first sample. They are used to synchronize the data set with other sensors or to synchronize the time-series on a regular interval (e.g., on the hour).
See Section 1-3 for details on sampling parameters listed below.	
AvgInterval	This varies with the interests of the deployment. It is typically based on real variations in water velocity: what averaging time is needed for a good mean value of the currents. The exception is for fast sampling for short deployments or in conjunction with burst sampling.
SampleInterval	This varies with the desired time resolution of currents and power / memory requirements.
BurstMode	Burst sampling is not commonly used, but does allow monitoring of both short and long-term variations in the currents (§1-3).
BurstInterval	When using burst sampling, this is set based on the desired time resolution of currents and power/memory requirements.
SamplesPerBurst	When using burst sampling, this is set based on the desired time resolution of currents and power/memory requirements.

8-2. Battery Life and Data Storage Requirements

8-2.1. Battery Life

Power Consumption

- With the **AUTO** velocity range, the Argonaut-ADV consumes 0.5 W.
- Using a pre-set velocity range, the Argonaut-ADV consumes 0.25 W.
- The **AUTO** velocity range is recommended for the best performance except for severely power-limited applications (see the *Argonaut-ADV Principles of Operation*).
- Power consumption for the optional CTD must be accounted for (if installed). It is estimated by the equation below. For example, using an **AvgInterval** of 60 seconds, the CTD power will be 0.08 W (giving total power consumption of 0.58 W using the **AUTO** velocity range).

  CTD_Power (Watts) = 5 / AvgInterval (seconds)
- Power consumption for the optional YSI must be accounted for (if installed). It is estimated by the equation below. For example, using an **AvgInterval** of 300 seconds, the YSI power will be 0.17 W (giving total power consumption of 0.67 W using the **AUTO** velocity range). Because of its higher power consumption, the YSI is normally only used with slower sampling rates or with long averaging times.

  YSI_Power (Watts) = 50 / AvgInterval (seconds)
- The total power consumption is the sum of the Argonaut-ADV power consumption with any optional sensors (CTD or YSI).
- **IMPORTANT:** These power consumption values assume power is fed through the direct battery power connection to the Argonaut-ADV processor rather than through the secondary voltage regulator or the DC-to-DC converter (for systems with rechargeable batteries - see input power specifications in §6-1). Using the secondary voltage regulator or DC-to-DC converter increases power consumption by a factor of two during data collection, and during sleep mode (from <1 mW to 0.5 W).

Battery Pack Capacity

- SonTek recommends using 80% of the nominal battery capacity to allow for temperature variations (nominal capacities are at 20°C) and a reasonable safety margin.
- The Argonaut-ADV Autonomous alkaline battery pack outputs 12.0 V with a nominal capacity of 5.7 Ah. Using 80% of nominal capacity gives 55 Wh of energy.
- The Argonaut-ADV Autonomous rechargeable (NiCad) battery pack outputs 10.8 V with a nominal capacity of 2.0 Ah. Using 80% of nominal capacity gives 17 Wh of energy.
- The Argonaut-ADV Splash-Proof rechargeable battery pack outputs 12.0 V with a nominal capacity of 2.2 Ah. Using 80% of nominal capacity gives 21 Wh of energy.
- User-supplied batteries and power systems will have widely varying capacities, which must be calculated on a case-by-case basis.

Duty Cycle

- Duty cycle is the percentage of time the Argonaut-ADV is actively collecting data.
- When not collecting data, the Argonaut-ADV enters a low-power state (< 1 mW). Note power consumption in the low-power state is negligible only if using the direct battery power connection (see input power specifications, §6-1).
- When not using burst sampling, duty cycle is calculated as:
  (AvgInterval / SampleInterval)
- When using burst sampling, duty cycle is calculated as:
  ((AvgInterval * SamplesPerBurst) / BurstInterval)
- Battery life scales directly with duty cycle. For example, a duty cycle of 0.2 (20%) increases battery life by a factor of five.
- See Section 1-3 for a description of sampling strategies and duty cycle calculation.

Battery Life Calculation

- Battery life is calculated as follows.
  Battery_life = Battery_capacity / Power_consumption / Duty_cycle

Example 1: An Autonomous Argonaut-ADV with alkaline battery pack (no CTD or YSI) will be deployed using the **`AUTO`** velocity range, **`AvgInterval`** 120 seconds, **`SampleInterval`** 600 seconds, no burst sampling.

- Battery capacity is 55 Wh, power consumption is 0.5 W, which gives power for 110 hours (4.6 days) of continuous operation.
- Duty cycle is (120 / 300) = 0.2. Total battery life is therefore (4.6 / 0.2) = 23 days.

Example 2: An Autonomous Argonaut-ADV with rechargeable (NiCad) battery pack and external CTD will be deployed using the **`AUTO`** velocity range, **`AvgInterval`** 120 seconds, **`SampleInterval`** 120 seconds, no burst sampling.

- Battery capacity is 17 Wh; power consumption is 0.54 W, which gives power for 31.5 hours (1.3 days) of continuous operation.
- Duty cycle is (120 / 120) = 1.0. Total battery life is 23 days.

To Avoid Draining of Batteries When the System is Not in Use

- Always power the system off before storing the system to prevent draining the batteries.
- The Argonaut-ADV splash-proof configuration can be powered off using the switch on the front panel.
- All Argonaut-ADV configurations can be powered off by establishing direct communications using *SonTerm* and sending the command **`PowerOff`** (§3-7).

8-2.2. Data Storage Requirements

Data File Size

- The Argonaut-ADV stores 418 bytes of header information for each file.
- Each velocity sample uses 39 bytes (**`DataFormat LONG`**) or 23 bytes (**`DataFormat SHORT`**). When possible, we recommend using the **`LONG`** data format.
- The integrated CTD adds 16 bytes per sample
- The integrated YSI sensor adds 16 to 30 bytes per sample, depending on the probe configuration. See your specific system for the exact sample size.
- It is not possible to have the CTD and YSI installed on the same system.
- All samples from an individual deployment are stored in a single file.
- The total file size is calculated as follows.

  File Size = 418 + (Bytes_Per_Sample * Number_of_Samples)

Recorder Capacity

- The standard Argonaut-ADV recorder has a 2-MB capacity (2,097,152 bytes).
- An upgrade to a 4-MB capacity is available (4,194,304 bytes).
- The standard (2-MB) Argonaut-ADV recorder is divided into 32 blocks of 64 KB. Only one data file can be written in one block (although one data file can occupy multiple blocks). The recorder can hold a maximum of 32 data files. If you record several small data files (less than 64 KB per file), the recorder will reach maximum capacity before 2 MB of velocity data have been stored.
- The upgraded (4-MB) Argonaut-ADV recorder is divided into 64 blocks of 64 KB. The recorder can hold a maximum of 64 data files.
- Be sure to format the recorder to erase all files before any deployment.
- The table below shows the maximum recorder capacity for all sample sizes.

Data Format	CTD	YSI	Bytes Per Sample	2-MB Capacity (Samples)	4-MB Capacity (Samples)
Long	No	No	39	53,000	107,000
Short	No	No	23	91,000	182,000
Long	Yes	No	55	38,000	76,000
Short	Yes	No	39	53,000	107,000
Long	No	Yes	55-69	30 – 38,000	60 – 76,000
Short	No	Yes	39-53	39 – 53,000	79 – 107,000

Calculating Recorder Life

- Example: An Argonaut-ADV with the standard 2-MB recorder, no CTD or YSI, will record **`LONG`** data format samples using **`AvgInterval`** 120 seconds, **`SampleInterval`** 600 seconds, no burst sampling.
- The data has 39 bytes per sample; recorder capacity is 53,000 samples.
- The recorder capacity will last over 360 days.

8-3. Starting an Autonomous Deployment

Autonomous deployments can be started two ways.

- From the direct-command interface using a terminal or terminal emulator (e.g., *SonTerm*)
- Using the Windows-based *ViewArgonaut* deployment software (see the *Argonaut-ADV Software Manual*)

This section describes starting an autonomous deployment using the direct-command interface. See Section 3 for details about the direct-command interface. The steps below include redundant checks to verify all aspects of Argonaut-ADV operation.

1. Run the diagnostic software *ArgCheck* (Windows version) or *ArgADVCk* (DOS version) to verify all aspects of system operation. See the *Argonaut-ADV Software Manual* for detailed instructions on using and interpreting the software.
2. Perform the deployment procedure with the Argonaut-ADV operating from the batteries that will be used for deployment. Do not disconnect power after initiating the deployment.
3. Perform a compass calibration if the compass/tilt sensor is installed (§4-4). This should be done with the system mounted in the deployment frame with batteries and other instrumentation installed.
4. Record all communication with the Argonaut-ADV for future reference. This can be done using the log file option in *SonTerm* (see the *Argonaut-ADV Software Manual*).
5. **`BREAK`** – To wake the system up and establish communication.
6. **`Show Conf`** – Check parameters.
7. **`Show System`** – Check parameters (§8-1.1). Modify parameters as needed.
8. **`Show Setup`** – Check parameters (§8-1.2). Modify parameters as needed.
9. **`Show Deploy`** – Check parameters (§8-1.2). Modify parameters as needed.
10. **`Save Setup`** – To save parameters (redundant – done by **`Deploy`** command).
11. **`Compass CONT`** – To check compass operation (if installed). Rotate and tilt the Argonaut-ADV to verify compass data (§4-1). Press any key to stop output.
12. **`Dir`** – Check for files on the internal recorder. Make sure there is sufficient space for this deployment. **`Format`** to erase the recorder if necessary.
13. **`Show`** – Verify parameters with all four “Show” commands one last time.
14. **`Deploy`** – To initiate the deployment.
15. Watch for any error messages. If practical, leave the computer connected to the Argonaut-ADV until the first sample has been output.
16. Disconnect the cable from the computer <u>before</u> turning the computer off. Some computers will send the equivalent of a **`BREAK`** over the serial port when turned off, which can interrupt the deployment and cause the loss of data.
17. Disconnect the communication cable, install the dummy plug, and deploy the Argonaut-ADV.

Section 9. Optional External Sensors

The Argonaut-ADV can include several externally mounted, integrated sensors.

- The sensors are connected to the Argonaut-ADV using special interface cables.
- The most commonly integrated sensor is the SeaBird MicroCat CTD.
- Another commonly integrated sensor is the YSI Multiprobe 6820.
- A range of other sensors (OBS, transmissometer, conductivity, etc.) can be integrated using analog output voltages. Depending on the type of sensor, it may receive input power from the Argonaut-ADV, or it may use a separate power supply.

For details on available sensors and configurations, contact SonTek.

9-1. SeaBird MicroCat CTD

The SeaBird MicroCat CTD with RS232 serial interface provides high quality conductivity, temperature, salinity, and (optional) pressure data. When integrated with the Argonaut-ADV, the MicroCat is sampled at the beginning of each averaging interval. Data are integrated in a CTD data structure within each Argonaut-ADV sample.

9-1.1. CTD Splitter Cable

Systems with the optional integrated CTD include a special splitter cable to connect the CTD to the Argonaut-ADV.

- The splitter cable connects to the Argonaut-ADV, the CTD, and the standard power and communication cable.
- The splitter cable routes power and communication between the CTD and Argonaut-ADV.
- The Argonaut-ADV includes additional internal wiring and software modifications to integrate the CTD.

9-1.2. CTD Data Storage / Output

CTD data is stored with each Argonaut-ADV sample.

- CTD data is stored and output with the full resolution provided by the CTD sensor.
- See Section 3-15 for details about CTD output data format.

9-1.3. Timing of CTD Data

The CTD is sampled once during each Argonaut-ADV sample at the beginning of the averaging interval.

- The CTD sample is taken 5 seconds after the start of the Argonaut-ADV averaging interval.
- The time reported by the Argonaut-ADV reflects the start of the averaging interval.
- An averaging interval of at least 10 seconds is required for the integrated CTD.
- The CTD system is put in a low-power sleep mode to conserve power except during the time required to take a sample.

9-1.4. CTD Commands

In normal operation, all commands to the optional external CTD are sent automatically and no direct commands need to be sent. The commands in this section are provided to assist in diagnosing problems and to give greater flexibility in Argonaut-ADV operation.

`H CTD`

- Displays help on external CTD sensor commands.

`CTD`

- Displays most recent temperature (°C), conductivity (Siemens per meter), pressure (decibar), and salinity (ppt) data from the external CTD sensor
- Data are output in a self-explanatory, ASCII-text format.

`CTD CONT`

- Displays continuous temperature (°C), conductivity (Siemens per meter), pressure (decibar), and salinity (ppt) data from the external CTD sensor
- Data are output in a self-explanatory, ASCII-text format.
- Press any key to stop data output and return to command mode.

`CTD Talk`

- Establish direct serial communication with the external CTD.
- A manual for the CTD sensor is included; see this manual for details on direct commands to the CTD.
- To return to command mode, type “+++” or send a **BREAK** to the ADP.

9-1.5. When Not Using the Optional CTD

Systems with the integrated CTD may occasionally need to be used without the CTD. This section explains how to "uninstall" and "install" the CTD for these occasions.

To Uninstall the CTD

- Establish direct communication with the Argonaut-ADV using a terminal emulator (*SonTerm*).
- **`BREAK`** to wake-up the system.
- **`Show Conf`** to check hardware parameters. Verify **`CTDInstalled`** is set to **`YES`**.
- **`CTDInstalled Set NO`** to uninstall the CTD.
- **`SaveSetup`** to save the parameter setting.
- **`Show Conf`** to check system parameters. Verify **`CTDInstalled`** is set to **`NO`**.
- The system can now be used without the CTD. Use the standard Argonaut-ADV cable without the special CTD splitter cable.

To Install the CTD

- Establish direct communication with the Argonaut-ADV using a terminal emulator (*SonTerm*).
- **`BREAK`** to wake-up the system.
- **`Show Conf`** to check hardware parameters. Verify **`CTDInstalled`** is set to **`NO`**.
- **`CTDInstalled Set YES`** to install the CTD.
- **`SaveSetup`** to save the parameter setting.
- **`Show Conf`** to check hardware parameters. Verify **`CTDInstalled`** is set to **`YES`**.
- The system can now be used with the CTD. Use the special CTD splitter cable.

9-2. YSI Multiprobe 6820

Not yet available. Contact SonTek.

9-3. External Analog Sensors

Not yet available. Contact SonTek.

Section 10. Additional Support

Any additional questions can be directed to SonTek by phone, FAX, or email. Regular business hours are 8:00 a.m. to 5:00 p.m., Pacific Standard Time, Monday through Friday.

Phone	(858) 546-8327
FAX	(858) 546-8150
Email	inquiry@sontek.com
World Wide Web	http://www.sontek.com

See our web page for information concerning new products and software / firmware upgrades.

Appendix A. Argonaut-ADV Binary Data File Format

The file format described in this appendix is valid for Argonaut-ADV CPU firmware versions 10.0 and later. For information about changes in the Argonaut-ADV data file format from previous firmware versions, contact SonTek.

A-1. Overview

The structure of an Argonaut-ADV binary data file with N samples is shown below. The size of each sample is a function of the setting of the data format parameter (**LONG** or **SHORT**) and what external sensors are installed (§8-2.2).

```
File Header 418 bytes
Sample 1 (23 – 69) bytes
Sample 2 (23 – 69) bytes
...
Sample N (23 – 69) bytes
```

The Argonaut-ADV file header consists of three binary structures in the following order.

```
Argonaut-ADV Sensor Configuration      96 bytes
Argonaut-ADV Operation Configuration   64 bytes
Argonaut-ADV User Setup Parameters     258 bytes
```

Each of the structures mentioned above are described in detail (using their C language definitions) in the remainder of this appendix.

A-2. File Header Structures

Each Argonaut-ADV file header structure is described below using the C language definition. The first structure, *Argonaut-ADV Date and Time Structure*, is referenced by other structures.

<u>Argonaut-ADV Date and Time Structure (8 bytes)</u>

```
typedef struct {
   int  year;
   char day,
        month,
        minute,
        hour,
        sec100,
        second;
} DateTimeType;
```

Argonaut-ADV Sensor Configuration Structure (96 bytes)

```
typedef struct {
  char     ConfigType;                /* Type      0x40              */
  char     ConfigVer;                 /* Version   0x02              */
  int      Nbytes;                    /* Bytes in configuration      */
  DateTimeType    ConfigTime;         /* Date created or last mod. */
  unsigned char   SoftwareVerNum;     /* Ver of Argonaut-ADV firmware   */
  unsigned char   DspSoftwareVerNum;/* Ver of DSP firmware         */
  char            BoardRev;           /* Electronics board rev       */
  char     SerialNumber[10];          /* Sensor serial number        */
  char     SystemType;                /* Low Nibble:0-3MHz 1-1.5MHz */
                                      /* High Nibble:                */
                                      /*     0 – MD                  */
                                      /*     1 – XR                  */
                                      /*     2 – SL                  */
  char     Nbeams;                    /* 2, 3, or 4                  */
  char     BeamGeometry;              /* 0- 2 Beams; 1- 3 Beams      */
                                      /* 2- 4 Beams, 1 Vertical      */
                                      /* 3- 4 Beams, Janus           */
  int      SlantAngle;                /* in 0.1 deg                  */
  char     SensorOrientation;         /* 0-down; 1-up; 2-side        */
  char     CompassInstalled;          /* 0-No;   1-Yes               */
  char     RecorderInstalled;         /* 0-No;   1-Yes               */
  char     TempInstalled;             /* 0-No;   1-Yes               */
  char     PressInstalled;            /* 0-No;   1-Yes               */
  char     CtdInstalled;              /* 0-No;   1-Yes               */
  int      XformMat[16];              /* From Beam to XYZ veloc.     */
  int      CompassOffset;             /* Degrees to East of North    */
  long     PressScale;                /* Nanobar per count           */
  long     PressOffset;               /* Microbar                    */
  char     PowerSaveMode;             /* if 1 system off after 5 min*/
                                      /*     idle in command mode    */
  long     SeabirdOutputDelay;        /* For Seabird Inductive modem*/
  unsigned char UserBaudRate;         /* Default serial baudrate     */
  int      PressScale_2;              /* pico decibar per count^2    */
  unsigned char CpuAddress;           /* Address for 485 mode        */
  char     Spare2[9];                 /* set to all 0s               */
} ArgSensorConfigType;
```

Argonaut-ADV Operation Configuration Structure (64 bytes)

```
typedef struct {
   unsigned char Bpar[64];
} ArgOperConfigType;
```

Argonaut-ADV User Setup Parameters Structure (258 bytes)

```
typedef struct {
  unsigned   char        ConfigType;/* Type      0x42            */
  unsigned   char        ConfigVer; /* Version   0x02            */
  unsigned   int         Nbytes;    /* Bytes in configuration    */
  DateTimeType           ConfigTime;/* Date created or last mod.*/
  int            Temp;              /* 0.1 deg C                 */
  int            Sal;               /* 0.1 ppt                   */
  int            Cw;                /* 0.1 m/s                   */
  unsigned int   BlankDistance;     /* in cm                     */
  unsigned int   PulseLength;       /* in cm                     */
  unsigned int   CellSize;          /* in cm                     */
  char           TempMode;          /* 0- User 1- Measured       */

  long           AvgInterval;       /* in s                      */
  long           SampleInterval;    /* in s                      */
  unsigned int   PingInterval;      /* in 0.1 s                  */
  unsigned int   BurstMode;         /* 0-Disabled; 1-enabled     */
  long           BurstInterval;     /* in s                      */
  unsigned int   SamplesPerBurst;

  char           CoordSystem;       /* 0-Beam; 1-XYZ; 2-ENU      */
  char           OutMode;           /* 0-Auto;     1-Polled      */
  char           OutFormat;         /* 0-Binary;   1-Ascii       */
  char           RecorderEnabled;   /* 0-DISABLED; 1-ENABLED     */
  char           RecorderMode;      /* 0-NORMAL; 1-BUFFER        */

  char           DeploymentMode;    /* 0-Disabled; 1-enabled     */
  char           DeploymentName[9]; /* Dir name in recorder      */
  DateTimeType   BeginDeploymentDateTime; /* in seconds since    */
                                    /* 00:00:00 Jan 1, 1980      */
  char           CommentLine1[60];
  char           CommentLine2[60];
  char           CommentLine3[60];

  char           AutoSleep;
  char           DynBoundAdj;       /* 0- No   1- Yes (XR only) */
  int            CellBegin;         /* in cm, vert. from Arg.    */
  int            CellEnd;           /* in cm, vert. from Arg.    */
  char           Spare1[2];         /* set to 0                  */
  char           DataFormat;        /* 0- LONG; 1- SHORT         */
  char           Spare2[3];         /* set to all 0s             */
} ArgUserSetupType;
```

A-3. Data Sample Structures

Each Argonaut-ADV sample will consist of several different data records, depending on the setting of the data format parameter (**LONG** or **SHORT** – see Section 3-8) and whether any external sensors are installed. The data records will be in the following order

```
Argonaut-ADV Sample      (22 or 38 bytes)
CTD Sample if present    (16 bytes)
YSI Sample if present    (16-32 bytes)
Checksum                 (1 byte)
```

There are two different Argonaut-ADV data sample structures, depending on the setting of the data format parameter.

Argonaut-ADV LONG Sample Structure (38 bytes)

```
typedef struct {
  unsigned char   SyncChar;         /* 1  Fixed 0xB1              */
  unsigned char   Nbytes;           /* 1  Including ChkSum        */
  unsigned long   Time;             /* 4  time as seconds since   */
                                    /*    00:00:00 Jan 1,1980     */
           int    Vel[MAX_BEAMS];   /* 6  Vel in mm/s             */
  unsigned char   VelStd[MAX_BEAMS];/* 3  Vel in mm/s             */
  unsigned char   Amp[MAX_BEAMS];   /* 3  Amplitude in counts     */
  unsigned char   PercentGood;      /* 1  Percent good pings      */
  unsigned int    Heading;          /* 2  Heading in .1 deg       */
           char   Pitch;            /* 1  Pitch in .4 deg         */
           char   Roll;             /* 1  Roll in .4 deg          */
  int             Temp;             /* 2  in .01 deg C            */
  unsigned long   Pres;             /* 4  in A/D Converter counts */
  unsigned int    SigmaPres;        /* 2  in A/D Converter counts */
  unsigned char   Vbatt;            /* 1  Battery voltage         */
  unsigned int    BoundaryRange;    /* 2  in 0.1 cm units         */
  unsigned char   StdHeading;       /* 1  Std. Dev. in .1 deg     */
  unsigned char   StdPitch;         /* 1  Std. Dev. in .1 deg     */
  unsigned char   StdRoll;          /* 1  Std. Dev. in .1 deg     */
  unsigned char   ExtraByte;        /* 1  For future use          */
                                    /* 38 bytes                   */
} ArgLongSampleType;
```

Argonaut-ADV SHORT Sample Structure (22 bytes)

```
typedef struct {
  unsigned char   SyncChar;         /* 1  Fixed 0xB1              */
  unsigned char   Nbytes;           /* 1  Including ChkSum        */
  unsigned long   Time;             /* 4  time as seconds since   */
                                    /*    00:00:00 Jan 1,1980     */
           int    Vel[3];           /* 6  Vel in mm/s             */
  unsigned char   MeanVelStd;       /* 1  Vel in mm/s             */
  unsigned char   MeanAmp;          /* 1  Amplitude in counts     */
  int             Temp;             /* 2  in .01 deg C            */
  unsigned long   Pres;             /* 4  in A/D Converter counts */
  unsigned char   Vbatt;            /* 1  Battery voltage         */
  unsigned char   ExtraByte;        /* 1  For future use          */
                                    /* 22 bytes                   */
} ArgShortSampleType;
```

<u>CTD Data Structure</u>

```
typedef struct {          /* # bytes*/
  long         Temp;      /*  4  in 0.0001  deg C                      */
  long         Cond;      /*  4  in 0.00001 mho                        */
  long         Press;     /*  4  in 0.001   dbar                       */
  long         Sal;       /*  4  in 0.0001  ppt                        */
} CtdType;                /* ---- */
/* 16  bytes total */
```

<u>YSI Data Structure</u>

```
Not shown here; contact SonTek for details.
```

A-4. Checksum Calculation

The Argonaut-ADV uses a checksum with each sample and whenever transmitting binary data over a serial port. The checksum is computed with the C function *ComputeCheckSum* included here. To understand how the checksum is computed, assume that a sample has been placed in a segment of memory (i.e., a character array). The checksum value is stored as the last byte in this array. The checksum is computed by the following C program statement.

```
CheckSum = ComputeCheckSum( buffer, Sample_Length – 1 );
```

In this statement, *buffer* is a pointer to the memory location where the sample begins (i.e., the name of the character array where the sample was placed). *ComputeCheckSum* adds the first *Sample_Length – 1* bytes starting at location *buffer*, and then adds the value 0xA5. The result of this summation is truncated to one (unsigned) byte and returned. The addition of the value 0xA5 is done so that an all-zeros sample does not produce a valid checksum.

```
#define CHECK_SUM_OFFSET   0xA5
unsigned char ComputeCheckSum( unsigned char *buf, int n )
{
  int i;
  unsigned char ChkSum = CHECK_SUM_OFFSET;
  for(i=0;i<n;i++) ChkSum += buf[i];
  return(ChkSum);
}
```

A-5. Examples of Binary Output Records

Data Format	CTD	YSI	Bytes Per Sample
Long	No	No	39
Short	No	No	23
Long	Yes	No	55
Short	Yes	No	39
Long	No	Yes	55-69
Short	No	Yes	39-53

Appendix B. Multiple Argonaut-ADV Operation using RS485

This section describes the simultaneous operation of multiple Argonaut-ADVs in RS485 mode. Each Argonaut-ADV system must be hardwired at the factory to use RS485 protocol.

B-1. Overview

RS485 serial communication protocol allows multiple systems to be controlled from a single communication line.

- RS485 uses the same electrical communication protocol as RS422, allowing operation over total cable lengths up to 1500 m (4500 feet).
- A RS422/RS232 converter is used to connect the RS485 Argonaut-ADV systems to a standard PC serial port.
- Each Argonaut-ADV is configured with a unique system address.
- All communication is prefaced with a system address; each Argonaut-ADV responds only to commands directed to its specific address.
- Operation and data collection for all systems is controlled from a single PC. Data from each system is stored in a separate data file on the PC.
- Multiple systems are “daisy-chained” together as shown in Figure 21.

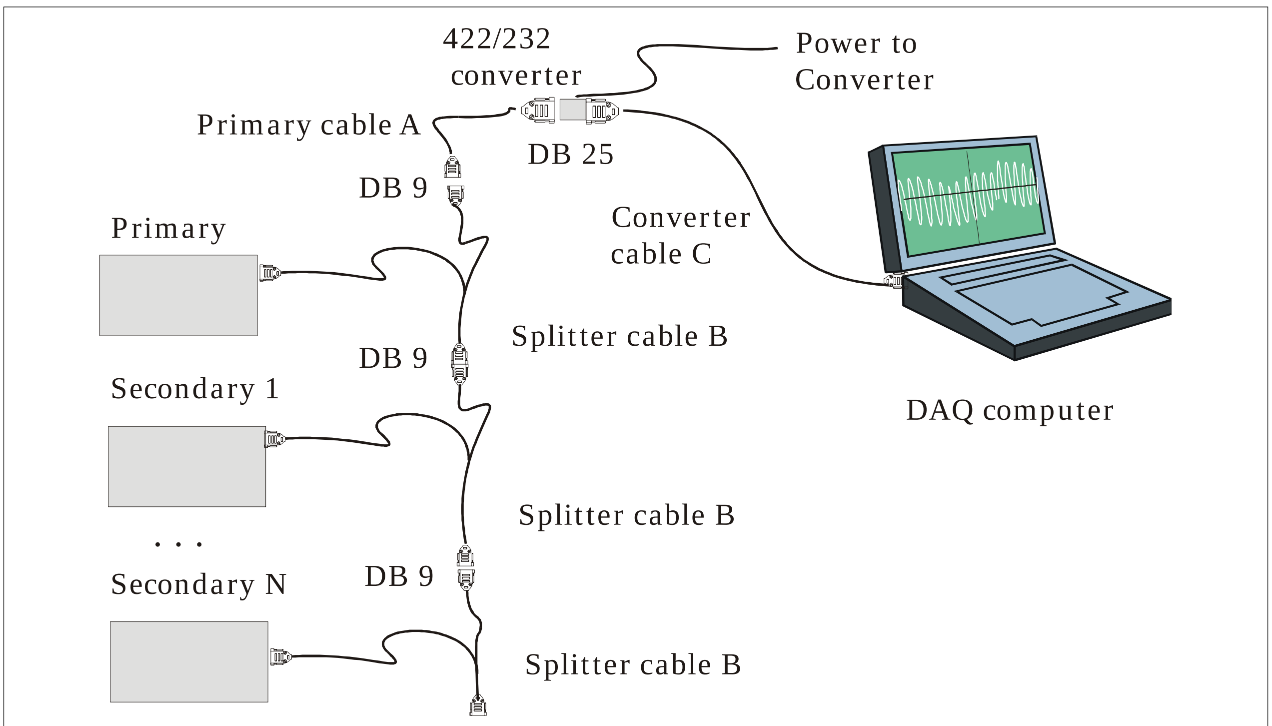

Figure 21 – RS485 Overview

B-2. Setting System Address

When RS485 systems are ordered, each Argonaut-ADV is configured at the factory to a unique CPU address (from 1 to 99). To change or verify this setting, use the following command to return the current CPU address.

```
>cpuaddress
```

To set the Argonaut-ADV to a particular address, use the following command, where N is the desired address (1 to 99). Setting an address of 0 will disable RS485 mode (for single system operation).

```
>cpuaddress set N
```

B-3. Cables and Connections

To use multiple Argonaut-ADVs in RS485 mode, you need to connect the systems together using the cables provided (Figure 20).

- Connect the DB25 of *Primary Cable A* to the serial port of your PC using the RS232 / RS422 converter. Connect power to the RS232 / RS422 converter using the small 12 V power supply provided with the system. You may need to use a DB25 to DB9 converter cable (*Converter Cable C*).
- Connect the DB9 of *Primary Cable A* to the female connector of *Splitter Cable B.*
- Connect the male connector of *Splitter Cable B* to the primary Argonaut-ADV.
- Continue connecting the splitter cables to all Argonaut-ADVs in the chain.
- Connect power to each of the Argonaut-ADV units (for systems without internal batteries).

B-4. RS485 Software – General

Only the Argonaut-ADV DOS-based, real-time software supports RS485 operation at this time; the Windows based real-time software does not support multi-system operation.

Operation of the software in RS485 mode is as described in the *Argonaut-ADV Software Manual*, with a few minor exceptions noted in the following sections.

B-5. SonTerm – RS485 Operation

When using *SonTerm* to communicate with a particular system on a RS485 chain, use the following steps.

- Send a **`BREAK`** (Alt+B) to the system.
- Use Alt+F1 to select a RS485 address.
- Send commands to that address as needed.
- To switch to a different system, again send a **`BREAK`**, and then select a new address using Alt+F1.

B-6. Real-time Data Acquisition Software – RS485

The following relates only to the DOS-based data collection software; the Windows real-time software does not support RS485 multi-system operation.

- To run several Argonaut-ADVs simultaneously, you need to create a file named **`ARGSENS.DEF`** in the same directory where the file **`ARGADV85.EXE`** is located (please note the name of the executable file).
- The definition file **`ARGSENS.DEF`** is an ASCII-text file with one line for each system. Each line specifies the CPU address that each individual system will use. The file should look something like the following (this is for three systems connected at addresses 1, 2, and 3).

```
SENSOR 1
SENSOR 2
SENSOR 3
```

- When file recording is chosen, **`ARGADV85.EXE`** will add *address_* in front of the file name you specify. For example, if you choose to record data into file **`run01`**, the software will create files **`1_run01.arg`**, **`2_run01.arg`**, and **`3_run01.arg`** corresponding to the systems on addresses 1 through 3.

B-7. ArgAdvCk and SonRec – RS485

The DOS diagnostic software *ArgADVCk* and the *SonRec* recorder extraction program have an additional *–address* command line option to specify the system address.

To run *ArgADVCk* on CPU address 2 and COM port 1 (-p1) use the following command line:

```
argadvck –p1 –a2
```

To run *SonRec* on CPU address 3 and COM port 1 (-p1) use the following command line:

```
sonrec –p1 –a3
```

Appendix C. SDI-12 Operation

C-1. Overview

Most existing river-gauging stations in the United States have standardized on the SDI-12 serial interface rather than the RS-232 communication protocol generally used by SonTek. The SDI-12 protocol simplifies integration of any compliant sensors into SDI-12- based data loggers because the data acquisition and control commands are independent of the internal language used by individual manufacturers.

There are two types of SDI-12 interfaces for the Argonaut-ADV.

- Systems produced before September, 2000 use an external SDI-12 interface.
- Systems produced after September, 2000 use an internal SDI-12 interface.

C-2. External SDI-12 Interface

Systems produced before September, 2000 use an external SDI-12 interface.

- The interface consists of an external module, which converts any Argonaut-ADV into an SDI-12 compliant sensor.
- A new set of commands has been implemented into the system firmware.
- All features previously available for the Argonaut-ADV are preserved, and the same instrument can be used in either RS232 or SDI-12 configurations.

C-2.1. Operation Overview

The external SDI-12 converter was designed to make integration of an Argonaut-ADV into an existing station as simple as possible. You do not need to learn a new communication language; you can use the same command set to communicate and retrieve data from the Argonaut-ADV as from any other SDI-12 sensor. The basic operating procedure is as follows.

- Configure the Argonaut-ADV for deployment by setting the averaging interval and other parameters using standard a RS232 serial communication cable and a PC.
- Start deployment by using the **`SAMPLE`** command.
- Disconnect the cable from the PC and connect the SDI-12 converter to the data logger and the Argonaut-ADV cable.
- In the SDI-12 data logger, assign a unique SDI-12 address to the Argonaut-ADV converter system.
- Configure your recorder to accept nine values from the Argonaut-ADV SDI-12 port.

During normal operation, the logger sends an address together with an SDI-12 *measure* command to the converter. The converter wakes up from its sleep mode and sends a series of commands to wake-up the Argonaut-ADV. After receiving an acknowledgment, the converter sends the initial command to the Argonaut-ADV. At the end of averaging interval, the converter receives the data from the Argonaut-ADV and stores it in a buffer. When the data logger sends a *retrieve data* command, these data are uploaded to the recorder. The converter then returns to sleep mode until receiving the next call from the logger.

C-2.2. New Output Data Formats

You can set the Argonaut-ADV to output data in Metric or English units (both in ASCII format). This option is selected using the **`OutFormat`** command, which offers the following choices:

- **`BINARY`** (Standard Argonaut-ADV binary format)
- **`ASCII`** (Standard Argonaut-ADV ASCII format, all integers)
- **`SEABIRD`** (Special format for interfacing to Seabird's inductive modems)
- **`METRIC`** (New ASCII output in Metric units)
- **`ENGLISH`** (New ASCII output in English or Engineering units)

The formats **`METRIC`** and **`ENGLISH`** have been added to facilitate use with SDI-12 data logging systems. See Sections 3-15.4 and 3-15.5 for the exact output formats.

C-2.3. SDI-12 Sampling Commands

For normal RS232 operation, you send a **`START`** or **`DEPLOY`** command to tell the Argonaut-ADV to begin data collection. With either of these commands, the Argonaut-ADV continues to collect data until interrupted. This mode of operation is not supported by all versions of the SDI-12 protocol. Even in versions that do support this mode of operation, it creates significant difficulties when a data logger is trying to synchronize the Argonaut-ADV samples with those from other sensors.

To remedy this problem, a new mode of operation has been added so that the Argonaut-ADV waits for a signal to start each sample. This new mode is started with the **`SAMPLE`** command. This command is identical to the **`START`** command except for one aspect. After the **`SAMPLE`** command is given, the Argonaut-ADV will wait for a command from the user before initiating each averaging interval. A flow diagram of the **`SAMPLE`** command operation is given below:

User Sends: **`SAMPLE`** *<CR>*

- The Argonaut-ADV performs all functions needed prior to data collection.
- Instead of starting the first averaging interval, the Argonaut-ADV goes into sleep mode to wait for a user request to start the first averaged sample.
- While in this mode, all of the Argonaut-ADV real-time commands are active (e.g., O, T, A, +++; see Section 3-14).
- In addition, a new real-time command (**`G`**) has been added for starting a new sample.

User Sends: *<CR> [<CR> <CR> ...]*

- As with other run-time commands, you must send one or more <CR> to bring the Argonaut-ADV out of sleep mode so that it is ready for a real-time command.
- The Argonaut-ADV will signal that it is ready by sending back the character **`$`**. After this, you have 10 seconds to send a valid real-time command.
- If the Argonaut-ADV does not receive any characters within 10 seconds, it will assume that it was awaken by a false signal on the serial port and go back to sleep. If this happens, you must again wake-up the system with a <CR>.

User Sends: **`G`**

- This instructs the Argonaut-ADV to start collecting and averaging data for the period specified by the current **`AvgInterval`** setting.
- Immediately after receiving the **`G`** command, the Argonaut-ADV will acknowledge its receipt by responding with the message:

  S*ddddd*<CR><LF>

  where *ddddd* is the value of the current **`AvgInterval`** setting in seconds. If the value has less than five significant digits, zeros are added to the left (i.e., **`S00060`**<CR><LF>).
- After this acknowledgement is output, the Argonaut-ADV will collect/average data for an **`AvgInterval`** +/- 1 seconds. On completion, the Argonaut-ADV will output the averaged data automatically if the **`OutMode`** was set to **`AUTO`**. If **`OutMode`** is set to **`POLLED`**, the instrument waits for the appropriate run-time command (**`O`**) to output data.
- After this, the Argonaut-ADV will return to the sleep mode in wait for another user request.

C-2.4. Starting Data Collection Using SDI-12

This section describes a basic procedure for configuring and connecting an Argonaut-ADV to an SDI-12 compliant data logger using the external SDI-12 converter.

1. Connect the Argonaut-ADV to a PC and a power supply using the SonTek power and communications cable (using RS232 communication).
2. Run the SonTek terminal emulator (*SonTerm*). Send a **`BREAK`** to wake-up the Argonaut. After communication has been established, configure the Argonaut-ADV as follows.
   - Set **`AutoSleep`** to **`ON`**.
   - Set **`OutMode`** to **`AUTO`**.
   - Set **`OutFormat`** to **`METRIC`** or **`ENGLISH`** as desired.
   - Set **`DataFormat`** to **`SHORT`**.
   - To store data in the Argonaut-DVL's internal recorder (in addition to being logged onto an SDI-12 data logger) set **`Recorder`** to **`ON`**. Otherwise, set **`Recorder`** to **`OFF`**.
   - Set desired **`AvgInterval`**.
   - Set **`SampleInterval`** to the same value as **`AvgInterval`**.
   - Store all settings in the Argonaut's CPU memory (**`SaveSetup`**).
   - Put the Argonaut-ADV into single-sample data acquisition mode (**`Sample`**).

```
>autosleep yes <CR>
>outmode auto <CR>
>outformat metric <CR> or >outformat english <CR>
>dataformat short <CR>
>recorder on <CR> or >recorder off <CR>
>avginterval XXX <CR>
>sampleinterval XXX <CR>
>savesetup <CR>
>sample <CR>
```

3. At this point, the Argonaut-ADV is ready for deployment, and you may disconnect the power and communication cable. (Note: The Argonaut-ADV will go back to SAMPLE mode after the power is reconnected).
4. Attach the SDI-12 converter to the Argonaut-ADV communication cable using the cable provided with a 5-pin male connector on one end and DB-9 and power connectors on the other end.
5. Connect the SDI-12 converter to the data logger and power using the other cable (with a 4-pin female connector on one end and four bare wires on the other). Connect the wires as shown in the table below.

Wire Color	Function
Red	+12 VDC
White	SDI-12 data
Black	Ground
Silver	Ground

C-3. Internal SDI-12 Interface

(This section is not yet complete; contact SonTek for more information.)

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