

# AQUAROD®

## *Operating Manual*

*Version 5.01*



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# CAUTION

## **ONLY DEPLOY YOUR AQUAROD “WET”**

The inner coating in the Rod absorbs a small amount of water. Your **AQUAROD**<sup>®</sup> has been calibrated at the factory in a “wet” condition. This is the state in which the instrument will be the most accurate. The AquaRod has been shipped in this state. Remove the cap at the bottom of the rod and the tape at the top of the stainless steel portion of the rod just prior to deploying. To “wet” a rod, if you have let it dry out, immerse the rod in water up to the vents that are just below the base of the pod for about 24 hours. A rod will stay “wet” for about 24 hours, and so should be wetted within a day of deployment.

**Once deployed the rod will remain “wet” as long as the tip of the inner rod remains submerged.**

If the rod is deployed “dry” the water level reading will be understated by approximately 3% of the wetted length until it is fully “wetted” (approximately 24 hours later).

**Data Logger Time / Date stamp:** The time, date and logging interval must be re-set ***each time*** the battery is removed or replaced. **Data is NOT lost** during the removal or replacement of the battery, however the time / date and logging interval setup must be reset.

## **Users Who Already Own AQUARods:**

You will notice changes in the cap (now clear) and electronics from previous version of the **AQUAROD**<sup>®</sup> instrument. Most notably, the instrument now has a slide on/off switch. Green, (forward position) is “ON and Red (back) is “OFF”.

Please note that all single-piece style units (with phone jack) are compatible with the new PDA option.

If you own a first or second generation **AQUAROD**<sup>®</sup> (separable rod and pod) please read Appendix 2, where specific steps are described to help you use your older files with the new software.

## UNPACKING AND SOFTWARE INTALLATION

The 2 meter *AquaRod*<sup>®</sup> is shipped in an ABS tube that can be used for future transport of the instrument. Half meter and 1 meter rods are shipped in special Triangular shipping boxes. ABS shipping containers, such as the one below, are available from the factory as an option.

**DO NOT REMOVE THE CAP OR TAPE UNTIL YOU ARE READY TO DEPLOY.** A small box or packet is shipped separately, which contains the Communication Cable, Operating Manual, and **AQUAROD** software disk when ordered. The contents of the tube and box are shown below. Software can now be e-mailed to you as can the operators manual



### ***Software Installation***

To install the software for the first time, place the disk labeled **AQUAROD 4.xx** into the CD or floppy drive. On you computer In Explorer find **ARWinSetup410.exe** or **ARPalmSetup410.exe** if using the the Palm or Visor PDA double click on each of them follow the on screen instructions to complete the installation.

## TECHNICAL SPECIFICATIONS

### **Technology**

- Concentric Rod Capacitance

### **Parameters Measured**

- Water Level
- Water Temperature (optional)
- Air Temperature (optional)

### **Water Level Measurement**

- Range: three models, (AR50) 1.5 feet (0.5m), (AR100) 3 feet (2m) and (AR200) 6 feet (2m)
- Precision: 0.00328 feet (1 mm)
- Accuracy: 1/100 ft (AR 50 and 100), 2/100 ft (AR200)

### **Operating Temperature**

- Water: -5°C to +35°C
- Air: -20°C to +60°C

### **Measurement Modes**

- Sample Interval:  
Selectable from 1 - 6, 10, 12, 15, 20, or 30 minute intervals
- Trigger Delta:  
Programmed to check water level at the set interval but only record data on the hour or if level changes beyond preset threshold. Valid threshold values are 1 to 9 counts (change of 1 count is approximately equal to a change of 1mm).

### **Data Capacity**

- 9500 records of date, time, water level, water temperature (optional), air and air temperature (optional).

### **Interface**

- Communication Cable or PalmOS PDA device
- Windows® 95/98/2000/NT/ME/XP compatible Software
- AquaPAC PalmOS software

### **Power Supply**

- One 3.6V Lithium battery: Tadiran TL-2155/SBP or equivalent  
3.6V Lithium 2/3 AA 1450 mAh  
Diameter 0.58" (14.73 mm) Height 1.28" (32.51 mm)  
Pressure Contact

### **Physical Dimensions**

- Logger: 1.75" diameter X 13.5" long
- Rod: 0.625" diameter X 0.5, 1.0 or 2.0 meter lengths
- Logger and Rod are one unit and cannot be separated.
- Assembled weight in air: 5 lbs maximum (2m rod)

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## Section 1: AQUAROD DESCRIPTION

### *Introduction*

The **AQUAROD**<sup>®</sup> (Figure 1) is designed to log the water level in wells, streams, rivers, and lakes. The instrument consists of two main parts: the **Logger**, containing the electronics for data acquisition and logging; and the **Rod** used for determining water level changes. The latest generation of **AQUAROD**<sup>®</sup> has the Rod and Logger permanently connected.



Figure 1. **AQUAROD**<sup>®</sup> Assembly

The **AQUAROD**<sup>®</sup> records data in two modes. **Sample Interval** mode stores data at preset time intervals (1 - 6, 10, 12, 15, 20, or 30 minutes). In **Trigger Delta** mode the instrument checks the water level at the preset interval, but will only record a sample if the level has changed by more than a preset threshold since a sample was last recorded. The threshold can be varied from 1 to 9 raw counts (a change of 1 count corresponds to a change of approximately 1mm in water level) in one-count increments.

To operate the **AQUAROD**<sup>®</sup>, the date and operating mode information are entered into the pod using the Communication Cable and a computer. The **AQUAROD**<sup>®</sup> is “turned on”, and will begin to sample, when the on/off button is set to the proper position. To signal that the instrument is functioning properly, the logger will emit a long beep followed by a single sharp beep the first time it takes a sample. The first sample will be taken right after turning on the Pod. Two beeps will sound as the second sample is taken. The timing of the second sample is dependent on the programmed interval. When the Pod is turned off a High-Low-High-Low tone will sound. The Pod will only beep on the first two samples.

## Logger

The black pod houses the electronics of the instrument.

The newly redesigned **AQUAROD**<sup>®</sup> functions like its predecessors, with a few exceptions. The most visible change is the new design of the pod cap, which now sports a clear plastic cover piece. The cover piece allows the user to turn the instrument on and off, program the instrument, and download the data without exposing the board to the elements. This cover piece seals to the anodized aluminum pod via O-rings on either end.

The top piece will still need to be removed to replace the battery.

To turn the instrument on, unscrew the plastic cover piece. Note that it can be turned over and screwed upside down on the top of the Pod to avoid losing the piece. You might need to slightly loosen the metal pod cover to align the oval openings with the switch and LED. The on/off switch is a slide-toggle type, seen in the photo to the right as a small white rectangle in the bottom-left side of the opening. The instrument will beep when turned on and make a two-tone signal when it is turned off.

The red LED indicator is in the right-upper side of the opening and blinks whenever a data point is taken.

On the opposite side of the board, the headphone jack-style download port can be accessed. In the photo to the right, it is located on the left-hand side of the board. To program and/or download data, the instrument must first be turned OFF via the switch discussed above. Then, with the cover removed, the port can be accessed as before.

At the preset time interval, **and on every hour**, the pod checks the position of the Start switch. If the Start switch is in the OFF position, the electronics shut down and power up at the next time interval and the process is repeated. If the Start Switch is in the ON position, the electronics will record the three parameters, water level, air temperature and water temperature.

The **AQUAROD**<sup>®</sup> functions either in a **Sample Interval** mode, where it will store data at every preset interval, or in the **Trigger Delta** mode. In the Trigger Delta mode, the pod



is programmed to store data *only* on the hour or if the level has changed by more than the preset threshold since the last stored sample. This function is used to maximize available memory for long deployments.

Logger memory is non-volatile and removal of the battery will only reset the current date, time, and sample interval. **No stored data is lost** if the battery is removed.

## ***Rod***

The rod is the capacitance gauge that is used to measure water level. It is comprised of two tubes – one inside the other. The inner tube is coated with a dielectric material. When in use, water enters the region between the tubes. The height of the water determines the capacitance between the two tubes. The inner tube has a water temperature sensor at its lower end. The outer tube has two vent holes at its upper end. The Rod is permanently connected to the Pod.

## ***Communication Cable***

The Communication Cable (Figure 3) has a head phone style connector which connects to the Pod and a DB-9 plug for connection to a computer serial port. To program or download data from the **AQUAROD**<sup>®</sup>, the Communication Cable must be inserted into the mating connector on the main circuit board.

## ***PalmOS PDA device and the AquaPAC software***

A PalmOS PDA preloaded with a special version of the **AQUAROD**<sup>®</sup> software is now available. The PDA connects directly to the **AQUAROD**<sup>®</sup> and can program, download, and take real-time data from any phone jack enabled **AQUAROD**<sup>®</sup>. It can also display the data acquired in either a plot or table, giving immediate feedback to the user. The calibration for each rod can be preloaded, thus the data can be displayed in either English (1/100ft) or SI (meters) units. The AquaPAC software is described in a separate manual.

## SECTION 2: AQUAROD 4.00 SOFTWARE

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### **Software Operation**

Connect the pod to your PC using the Communication Cable. See the Communications Cable Section on the previous page for the details of connecting the cable to the AQUAROD® and to the PC.

To run the **AQUAROD 4.00** software:

click on **Start → Programs → Advanced Measurements → AQUAROD**.

Note: The software default is serial port “COM1”. This must be the same as designated on your PC. If the serial port on your PC is designated “COM2”

click on the settings icon ,  
click on the “Serial Port” tab  
use the pull-down menu to change the “COM1” to “COM2”.

If “COM2” is your standard connection  
click on the “Save As Default” box, then  
click ‘OK’


To use the **AQUAROD®** software:

click on the red traffic light icon  to change it to a green light .

This initializes the communication port and will light-up all the icons on the tool bar.

Use the following instructions to program or download your **AQUAROD®**, or refer to the Software Flowchart on page 14.

## Programming

To program the mode and timing variables into the **AQUAROD**<sup>®</sup>, connect the pod to the PC using the Communication Cable and click on the Set Instrument icon  to set the parameters for deployment (see Figure 2).

The instrument clock is automatically set to the computer date and time (in military time format).

Choose the appropriate mode of operation for the planned deployment. If you select **Sample Interval** mode, the interval is adjustable using the pull-down menu. The **Trigger Delta** mode allows you to adjust the water level change threshold (1 through 9mm are valid entries). Any water level change in excess of the threshold triggers the instrument to record the measurement.

Select **Add to pod memory** for the future data to be appended to any data already in memory or **Reset (ERASE) pod memory** to erase any existing data in the pod.

Click the **Set Instrument** button and the pod will be programmed with the selected settings. When the software is done programming the instrument, the **AQUAROD**<sup>®</sup> status window (see Figure 3) will appear, for verifying the pod's new settings. If the **AQUAROD**<sup>®</sup> is set correctly, click **OK** to close the **AQUAROD**<sup>®</sup> Status window. If the settings are not correct, click **OK**, fix the settings in the Set Instrument window, and re-click the **Set Instrument** button.

Another **AQUAROD**<sup>®</sup> may be programmed at this time by connecting the next pod to the Communication Cable, adjusting the mode settings (if necessary) and clicking on **Set Instrument**. When finished programming pods, click **Cancel** to close the Set Instrument window.

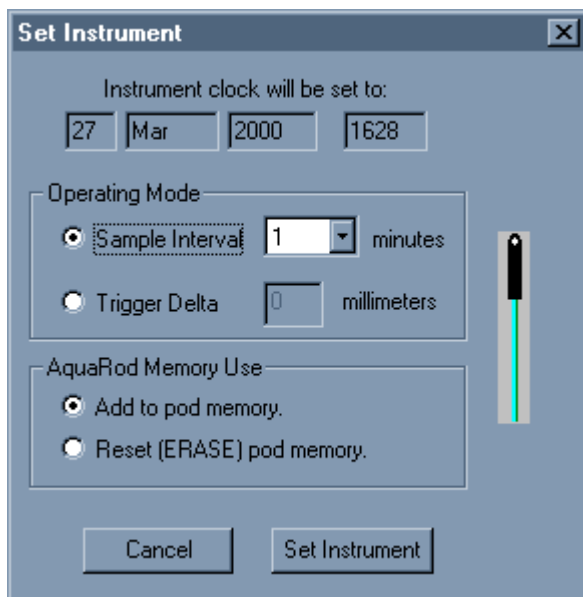


Figure 2. Set Instrument window.

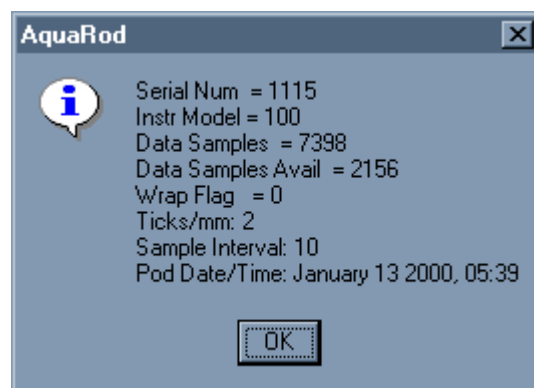



Figure 3. **AQUAROD**<sup>®</sup> Status Window.

## Downloading

With the Pod connected to the PC via the Communication Cable click on the Download icon  to retrieve data from Pod. The download may take up to five minutes. There is a download status bar in the lower right section of the window.

When the download is finished the **Select AQUAROD Data File** window will appear (see Figure 4). A file name needs to be entered to save the data. It is recommended that the filename represent the location of the data taken, the date the data was taken, and the serial number of the **AQUAROD**<sup>®</sup> used (e.g., BigRiver\_3\_00\_2094). This naming convention will make it easier to identify the contents of data files by name.

Click Save, and the **AQUAROD**<sup>®</sup> software will create a calibrated **data** file with a “.dat” extension (e.g., BigRiver\_3\_00\_2094.dat). In addition, the software automatically creates a **raw** (uncalibrated) backup file with a “.raw” extension (e.g., BigRiver\_3\_00\_2094.raw). The raw file is created solely as a backup file and contains the uncalibrated data.

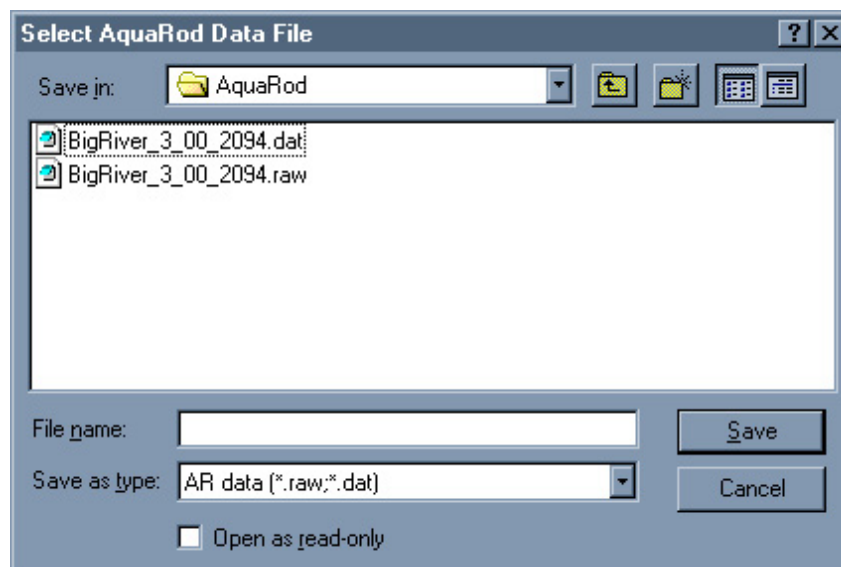




Figure 4. Select **AQUAROD** Data File.

## Opening Existing Files

To open an existing data file click on the Open icon . Select the data file and click “Open”. The File will be opened and the data will be displayed graphically.

**NOTE:** To view the data in text format, open the file using Notepad or import the data into Excel.

## Converting Raw Files to Data Files

To convert a raw file into a calibrated data file, click the Open icon . Select the data file and click “Open”. The raw file will be automatically converted to a data file and a graph of the data will open. To save the file as a data file, Click on **File** → **Save as Calibrated Data**. Enter the name for the data file and click “Save”.

**NOTE:** This function will only work with raw files created by **AQUAROD 4.00** and its updated version of AR.Com. For converting old raw files see Appendix 2.

## AQUAROD<sup>®</sup> Data

### Graph Description

The graph of the data that is displayed is meant only to be a quick and simple representation of the data (See Figure 5). It displays only water level and water temp, air temp is not displayed. **It is intended to be used as an easy way to initially look at the data, not as an analysis tool.** To properly analyze the data, the data file should be imported into a suitable program such as Excel.

It should be noted that the horizontal axis of the graph, labeled time, is actually each sample in order. Regardless of whether measurements were recorded at irregular time intervals, such as in Trigger Delta mode or possibly when new data was added, the data points will be evenly spaced on the graph. This can have the effect of visually “squishing” the graph.

**NOTE:** For proper analysis and display of the data, the data file should be imported into a spreadsheet or Data Analysis program and analyzed and graphed there.

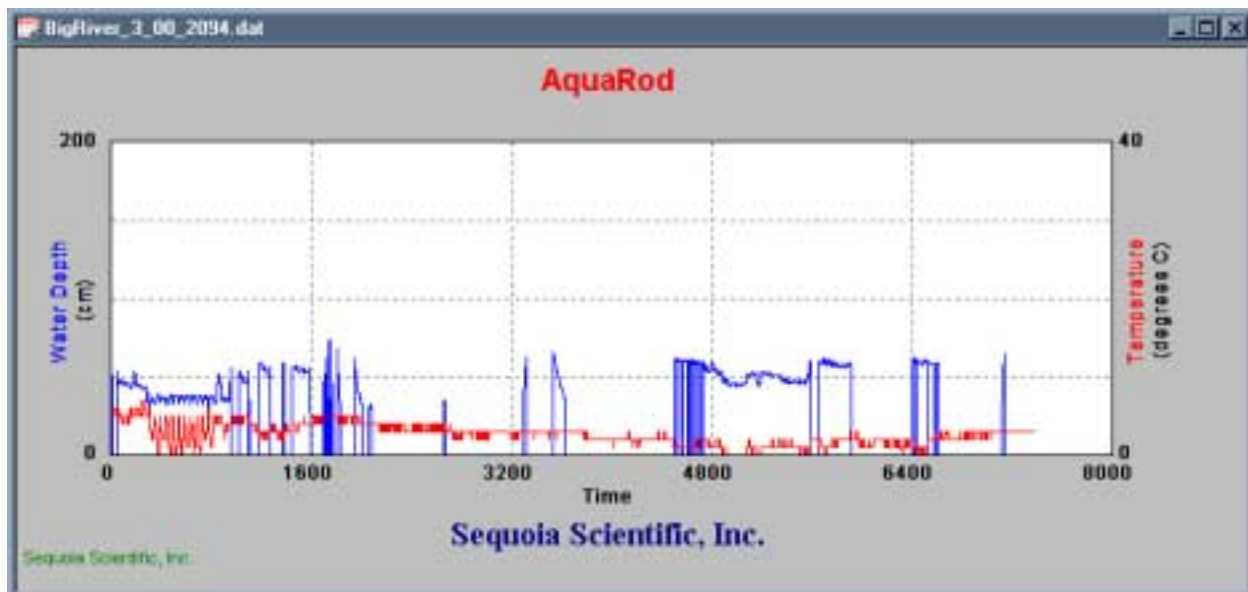


Figure 5. Graph of AQUAROD<sup>®</sup> Data.

## The Data File:

An example of the text of a data file (as it would be seen in a text editor) is shown in Table 1, below.

Table 1 **AQUARod**<sup>®</sup> Data File

Indicates the type of file.    DAT = Data file  
                                      RAW = Raw file

Data Records is the number of samples that were stored in memory and downloaded.

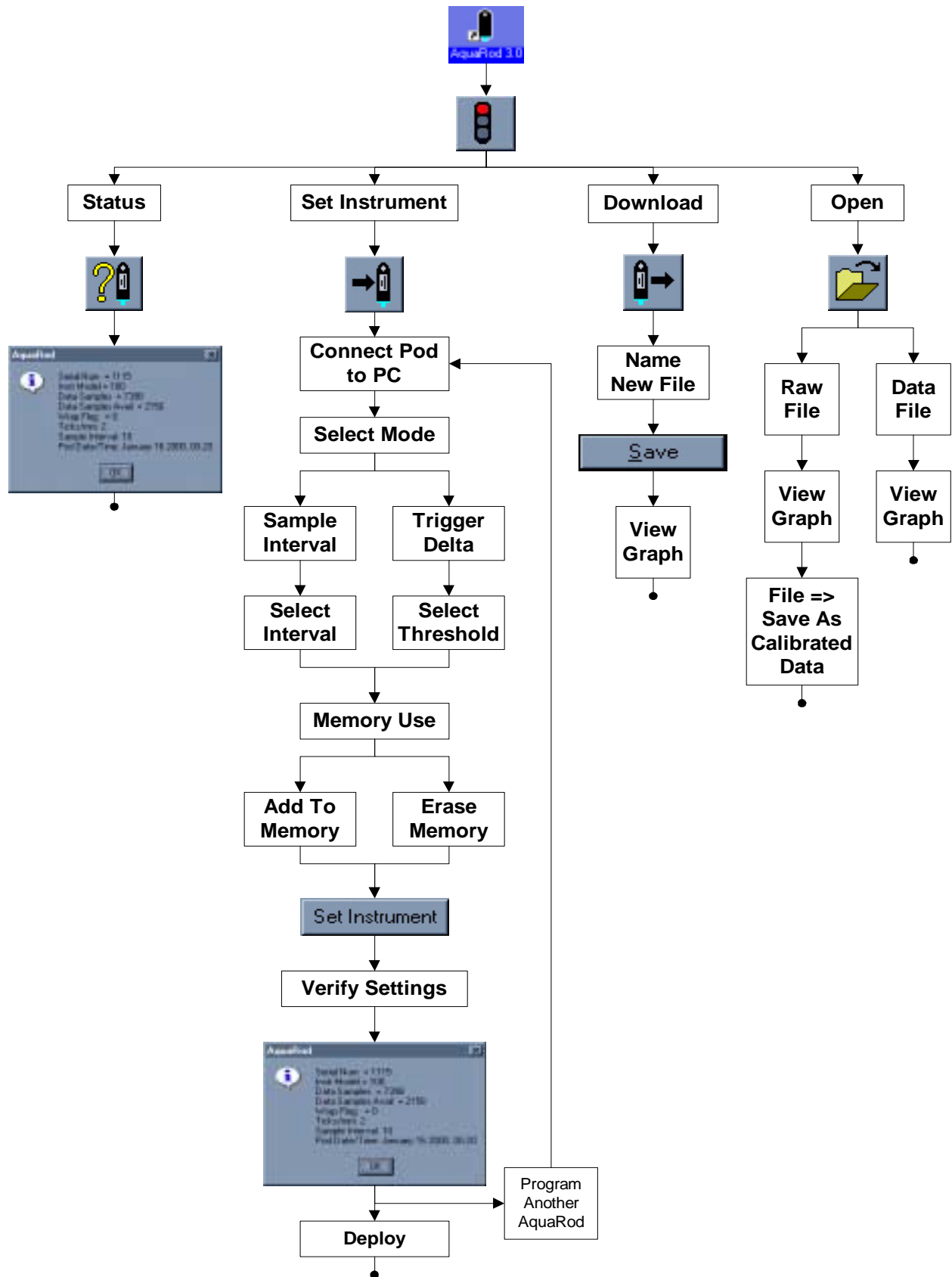
Serial number of the **AQUARod**<sup>®</sup> that took the data

Model (length) of the **AQUARod**<sup>®</sup> that took the data

Key to the data columns below.  
WT = Water Temperature (°C)  
AT = Air Temperature (°C)  
WL = Water Level (mm from the tip of the rod).

DAT
Data Records: 11
Serial Number: 2070
Model: 100
Date Time WT AT WL
03/28 16:08 24 22 1098
03/28 16:09 24 22 1098
03/28 16:10 24 22 1098
03/28 16:11 24 22 1099
03/28 16:12 24 22 1098
03/28 16:13 24 22 1099
03/28 16:14 24 22 1098
03/28 16:15 24 22 1098
03/28 16:16 24 22 1097
03/28 16:17 24 22 1099
03/28 16:18 24 22 1098

# AQUAROD<sup>®</sup> Software Flowchart



## SECTION 3: INSTALLATION

### *General*

The **AQUAROD**<sup>®</sup> is a sturdy instrument. As a result, there are no delicate procedures for mounting. A loop is provided on the top of the pod for mounting and hanging; however, we recommend that the rod or the base of the pod be used for primary mounting. Mounting to the rod or the base of the pod allows removal of the pod cap for downloading without altering location of the rod or dismantling the mounting system.

Mounting to the rod will not interfere with any of the instrument's electronics or alter the accuracy of the unit. However the inner rod, located inside the outer rod, must be guarded from abuse. Scratches on the inner rod will damage the instrument. Also, there are vent holes located in the top of the rod just beneath the pod. It is important to keep the vent holes clear since they allow the water level to rise and fall in the rod. Similarly, the bottom of the rod must remain clear and free of blockage such that the water can easily flow in and out.

### *Stilling Well*

There are two common methods for installing the **AQUAROD**<sup>®</sup> in a stilling well. For a shallow well, insert two bolts spaced  $\frac{3}{4}$ " apart through the stilling well (see Figure 6). The pod's base will rest upon the two bolts that can then be used as the water level reference. In a deep well, the rod can be suspended by a line from its mounting hoop (located at the top of the pod). The length of the line must be considered in calculating the water level reference.

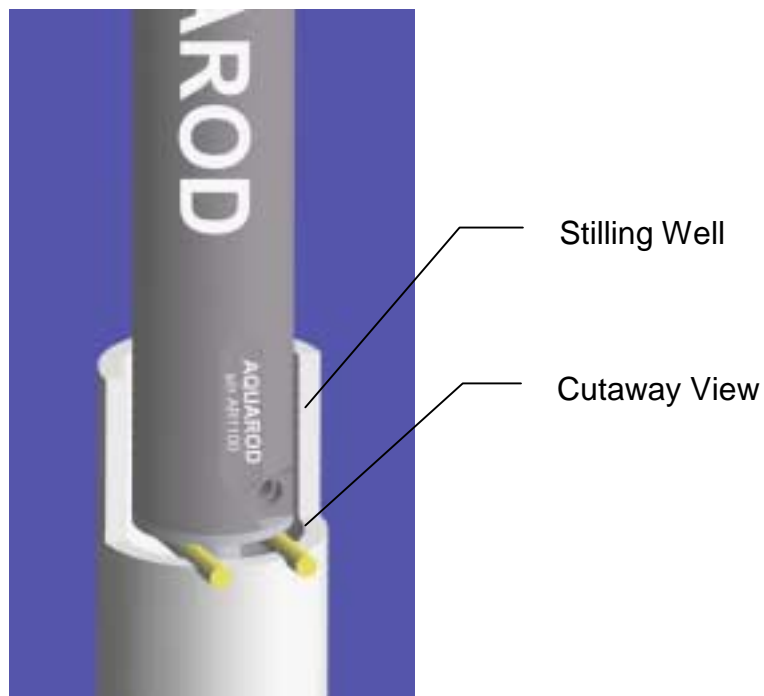


Figure 6. **AQUAROD** mounted in stilling well.

## ***Dock or Piling***

To mount the **AQUAROD**<sup>®</sup> to a (wood) piling the following items are required: two eyebolts (with a wood screw thread) having a large enough head for the rod to slip through but small enough to support the pod's base. McMaster Carr part number 9496T13 (23/32" ID, 2 5/8 Long Zinc-Plated Steel Wood Screw Eyebolt).

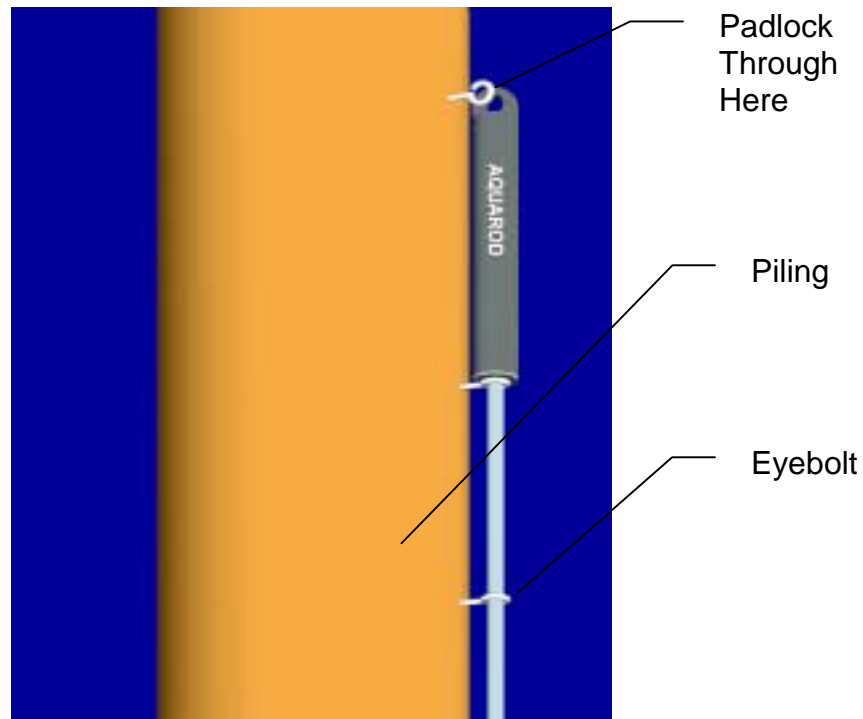


Figure 7. **AQUAROD** attached to piling.

Thread the two eyebolts into the piling one above the other, separated by a distance less than the length of the rod. Thread the eyebolts into the piling deep enough to be secure, but leave enough space between the eye and the piling for the pod. Insert the rod into the two eyebolts until the pod base is resting on the upper eyebolt. Use the upper eyebolt as a level reference.

[Optional] As a means of security a third eyebolt can be mounted above the other two and a padlock placed through the pod's mounting ring and the eyebolt (Figure 7).

## SECTION 4: MAINTENANCE AND TROUBLESHOOTING

### **Battery**

#### *Replacement interval*

It is highly recommended that the battery be changed after filling the data logger memory 5 times (47,500 samples). This number is approximate and should be used as a reference only. It is dependent on the temperature during operation, number of downloads, sample rate, and Trigger Delta use. Lithium batteries have a very flat voltage curve. Measuring the voltage of the battery is not an accurate way to measure remaining capacity. (Your data is important, we suggest fresh batteries for every deployment.)

#### *Replacement Procedure*

- Unscrew the top section of the pod and remove the cap.
- Insert new battery, ensuring that the polarities are correct.
- Reprogram **AQUAROD**<sup>®</sup> to reset date and time.
- Replace cover.

**NOTE:** No stored data is lost, but date, time and mode settings are reset.

#### *Battery Type Recommendations*

The 3.6V Lithium batteries is a 2/3AA lithium cell that is commonly used in cameras. The capacity at sub-freezing temperatures will be reduced. The **AQUAROD**<sup>®</sup> is shipped with a Tadiran 3.6V Lithium Battery Model number TL-2155/SBP, 1450mAh, with Pressure contact. The Tadiran battery is available from Newark Electronics for approximately \$6.50 (at the time of printing).

Newark Part# 92F2488

Newark phone 800-263-9275

The table below lists some alternate manufacturers of equivalent batteries. These batteries will work fine, but will have about 10% less capacity.

<b>Manufacturer</b>	<b>Part Number</b>
Duracell	DL123A
Panasonic	CR123A
Eveready	EL123AP
Kodak	K123LA
Varta	CR123A
Sanyo	CR123A
Maxell	CR123

## ***Troubleshooting***

### **No Response From Pod:**

- Make sure that the Communication Cable is properly connected to the Pod and the PC. If it is connected, try removing and reinserting the Communication Cable connector firmly to ensure a good connection.
- Make sure there are no other programs using the COM port running on the PC.
- Some laptops have trouble using the COM port for extended periods, particularly if the computer has an automatic “Sleep” function. Closing the program and rebooting the computer may help.
- Remove the Battery with the Communications Cable connected. Wait 5 seconds and remove the cable. Wait another 20 seconds and re-install the battery. Reconnect the Communications cable. Sample rate settings and date will be lost but data will remain in memory.
- Replace the battery. The **AQUAROD**<sup>®</sup> Communication Cable has a small electronic chip inside the DB-9 connector that is powered by the battery in the **AQUAROD**<sup>®</sup>. This chip takes more power than any other AQUAROD function, so if the battery is low, the AQUAROD may not be able to communicate even if it still functions normally (i.e. beeps when started).

## APPENDIX 1: AR.Com DOS PROGRAM

The AQUAROD<sup>®</sup> DOS program is named **AR.COM**. It was automatically installed with AQUAROD **4.00**. To use AR.Com, open a DOS window (Start→Programs→MSDOS Prompt) and change directories to the location of AR.Com (cd C:\Program Files\Advanced Measurements\AquaRod <enter>). The commands below are entered at the DOS prompt. There are two commands to operate the program.

**To Download:** AR/F*filename*.raw<enter>

*Filename* is the name of the raw file to be created (Maximum 7 Characters). This mode is used to download the contents of the pod's memory into a file. The format of the raw file is the same as that obtained when using AQUAROD **4.00**. **No calibration is performed** (to convert to a raw file to a data file see page 12).

**To Program:** AR/I*nn*/D*d*<enter>

*nn* is the sampling interval and *d* is the Trigger Delta value. Valid values for the sampling time interval are 1 - 6, 10, 12, 15, 20, or 30 (minutes). Valid values for the Trigger Delta level change threshold are 0 to 9 (mm). This mode automatically sets the pod's date and time to the computer's date and time.

The Trigger Delta value is optional, if the "/D*d*" is not used, the Trigger Delta value defaults to 0. **If Trigger Delta is used (if /D*d* is other than zero) the sampling interval should be set to 1.**

**Optional Parameters:** The AR program accepts the following optional parameters:

**COM Port selection:** /1 or /2

The program defaults to COM1. To switch the COM port, use /1 for COM1 or /2 for COM2.

**High Speed Baud Rate:** /H

This speeds the download of memory by about 20% by temporarily switching the baud rate.

### Examples:

To download a file to be named Ar2094 using COM2 at high speed, the command would be: AR/FAr2094.RAW/H/2<enter>

To program a pod to sample every minute with a Trigger Delta threshold value of 4 mm, the command would be: AR/I1/D4<enter>

To program a pod to sample every five minutes with no Trigger Delta, the command would be: AR/I5<enter>

**NOTE:** Upper or lower case letters can be used; the program is case insensitive. Spaces between the parameters are not required. Do not put a space between the /F parameter and the file name.

## APPENDIX 2: USERS WHO ALREADY HAVE AQUARODS

The latest design of the **AQUAROD**<sup>®</sup> is slightly different from earlier versions. The main difference is that the Pod and Rod are permanently connected. This was done to improve the robustness of the instrument and to simplify the task of downloading data in the field. Also, we eliminated the possibility of matching pods with the wrong rods (having different serial numbers). The battery was also changed from an alkaline battery to a lithium camera battery. The lithium battery will provide better performance in cold temperature conditions.

Software Version **4.00** is compatible with all the **AQUAROD**<sup>®</sup> instruments. If you are using a software version created earlier than Version **4.00**, you should switch to the newer software. After you have finished installing the new software onto your PC, it is important to move any cal files that you have (there is one for each AQUAROD you own) into the same directory as **AQUAROD 4.00**. The Default directory for installation is:

**C:\Program Files\Advanced Measurements\AquaRod**

Moving the cal files to this directory will allow the software to automatically select the proper cal file when you download.

To convert already existing files, created with older versions of AQUAROD software, into the same format as the new software:

Click **File**→**Open As**

Select the file that you wish to open.  
Select the type of file, i.e. "Old format raw data file" (see Figure 8)

Click **Open**

A new window will appear; select the appropriate cal file.

Click **Open**

The graph of the data will be displayed.  
Click "File→Save as Calibrated data file"  
to save in new style format.

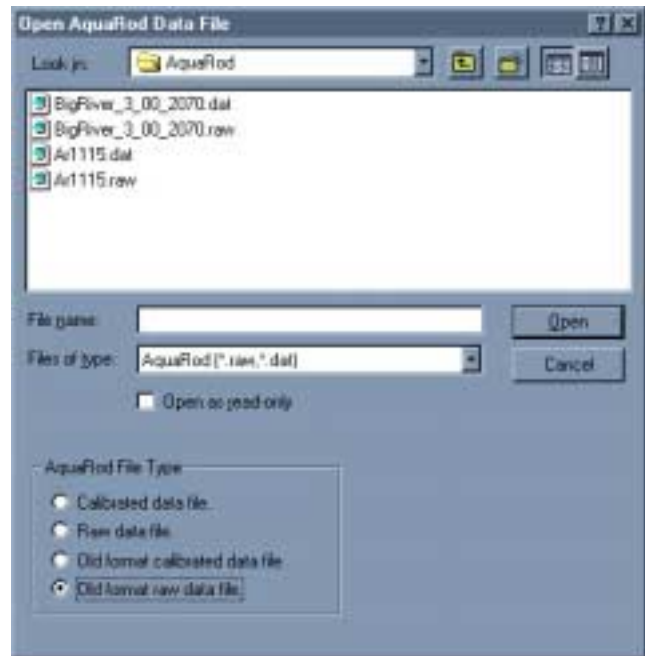


Figure 8. 'Open As' Window

**NOTE:** **AQUAROD 4.00** cannot determine the model and serial number from old data. If an old file is converted, these identity values will read zero. To change the values open the file using a text editor and change the values.