# H2O Acoustics
by ATS, Inc.

ARC800 Sensor Fish

Device & Software Operation Manual
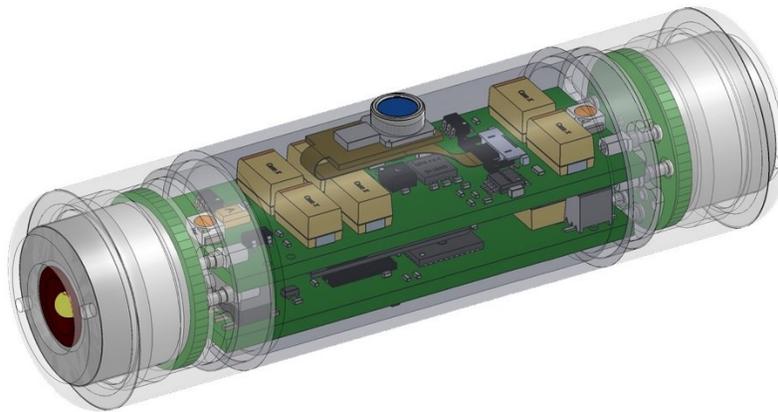
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This manual was written by Pacific Northwest National Laboratory (PNNL) and has been edited by ATS and presented here under license from PNNL.

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1.0 Functionality

1.1 System Overview

Developed by the Pacific Northwest National Laboratory (PNNL) and licensed to Advanced Telemetry Systems Inc., the ARC800 Sensor Fish Controller (SFC) software links to Sensor Fish, allowing users to control data collection settings and download data. It may also be used to convert native raw data (.raw2) files into Comma Separated Variable (.csv) files and plot the results. The multiple capabilities of the SFC allow hardware communication, data conversion, and data plotting with one application.

1.2 Software Requirements

The SFC will run using any of the following operating systems:
- Windows Server 2008 R2
- Windows Server 2008 SP2
- Windows Server 2003 SP2
- Windows 10
- Windows 7
- Windows Vista SP2
- Windows XP Professional SP3.

1.3 Hardware Requirements

Systems running the SFC software require:
- At least Pentium 233-megahertz (MHz) processing
- At least 64 megabytes (MB) of RAM (128 MB recommended)
- At least 1.5 gigabytes (GB) of available space on the hard disk.

1.4 System Installation

To ensure proper performance of the SFC on older systems, it may be necessary to install the appropriate Virtual COM Port (VCP) drivers. These can be located at (http://ftdichip.com/Drivers/VCP.htm.) Right click the "CDM v2.12.06 WHQL Certified.exe" file, choose "Run as administrator", and follow installation instructions.

A flash drive with the necessary files will be provided for program installation.

Step 1: Insert the flash drive into an empty USB slot and navigate to its contents.

Step 2. Double-click the "setup.exe" file to begin the installation process.
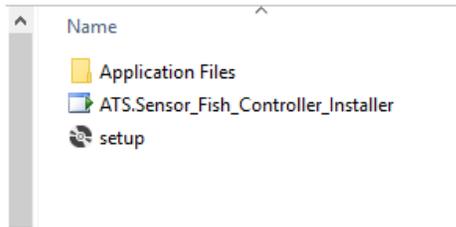
Step 3. Click install when prompted.
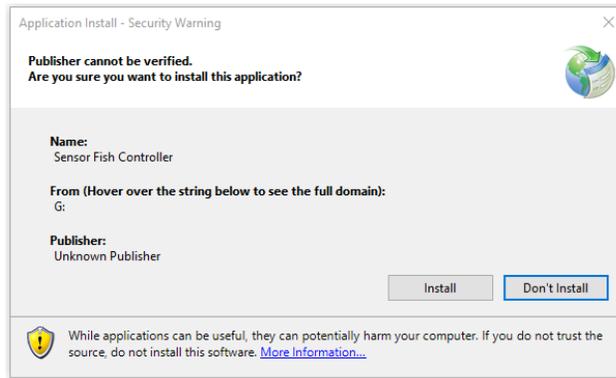
2.0   Getting Started

2.1   Launching the Application

After the initial installation, select the desktop icon or navigate to the icon in the start menu to run the application.

The application operates best when the user has administrator privileges on the computer being used. If this authorization is not obtainable, the user may run the program as the administrator by right clicking the program name and selecting "Run as Administrator".

After the ATS splash screen, the main interface will open:
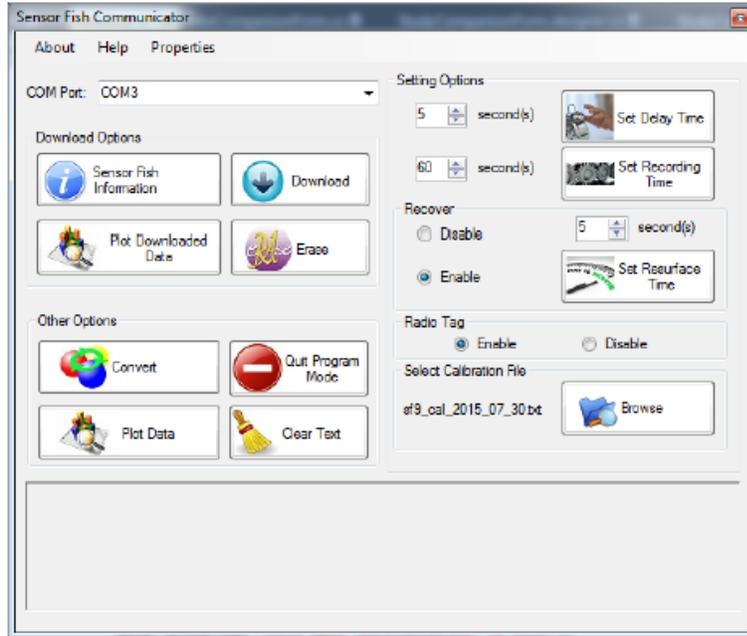
2.2 Select Serial Port

Click the COM Port dropdown box to choose the desired port. The serial port will be automatically connected after selection. The default speed is 921.6 kb/s. Selecting "Properties" on the menu bar reveals the default settings for the serial port, which are not accessible (grayed out):
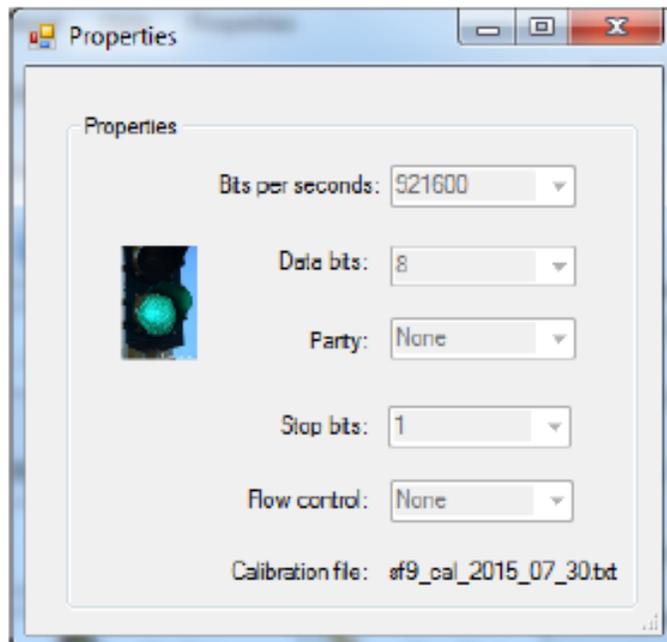
2.3 Connecting to the Sensor Fish

Please note that the connection pins, inside each end of the sensor fish, are very fragile. Take extra caution when plugging in the programming board AND the release boards. If a pin is broken, the sensor fish will need to be repaired by ATS, Inc. and does not fall under the warranty.

Connect the download cable to the Sensor Fish by first unscrewing the endcap on the lower end (yellow bead) of the Sensor Fish. Gently remove the Recovery Board Assembly by grasping the gray foam and pulling up, rocking it gently from side to side. Do not twist.

Connect the download cable to the Sensor Fish by pushing the cable's connector onto the now exposed pins of the Sensor Fish. Take care to line up the pin connections between the cable and the Sensor fish. Do not twist. This must be done gently or else the Sensor Fish pins could be damaged. A good connection is indicated by two red LEDs illuminated on the Sensor Fish.

2.4 Sensor Fish Information

Selecting the Sensor Fish Information button, indicated in the following figure, will return the version and serial numbers if the correct port has been selected and the Sensor Fish is connected.
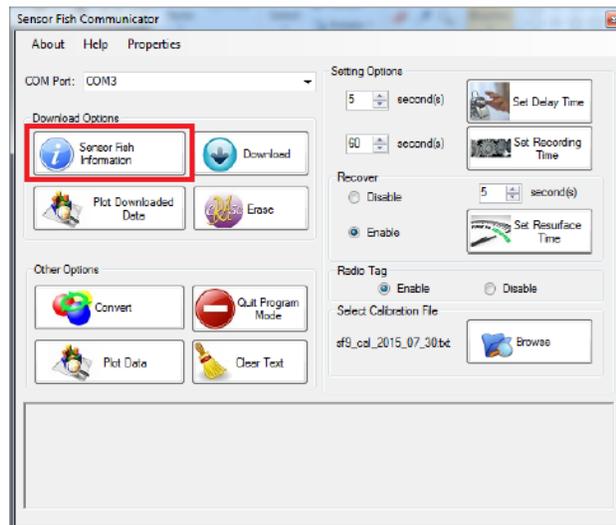
2.5　Erasing the Sensor Fish Data

Click the "Erase" button to clear the Sensor Fish of previously recorded data. This action can take as long as three minutes to complete, dependent on the set recording time. After erasing, the Set Delay Time, Recording Time, Resurface Time, and Radio Tag settings will need to be made. These steps are explained in Sections 2.5, 2.6, 2.7, and 2.8, respectively.
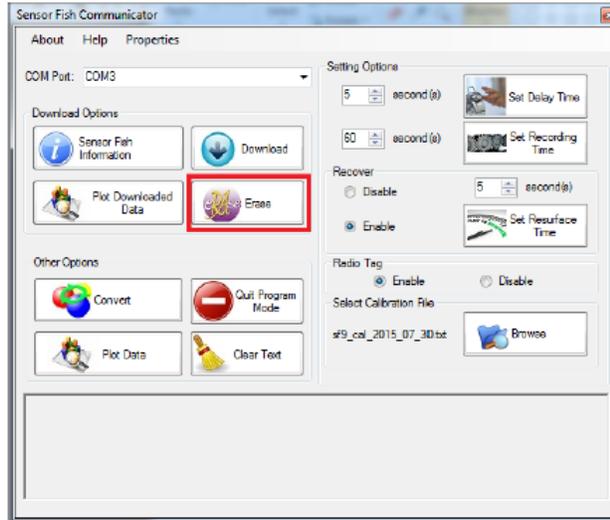

After selecting erase, a window will open asking for confirmation to erase the memory. Selecting "Yes" will begin the erase process, disabling the other functions in the Communicator until the erase task has completed. When finished, text will be displayed in the window at the bottom of the program.

2.6　Setting the Delay Time

The delay time is the time period the Sensor Fish waits before beginning data collection. Units are in seconds; the default is 5 seconds. Using the selection menu, enter the desired delay time and the click the "Set Delay Time" button. Once set, the selected time will be displayed in the text window.
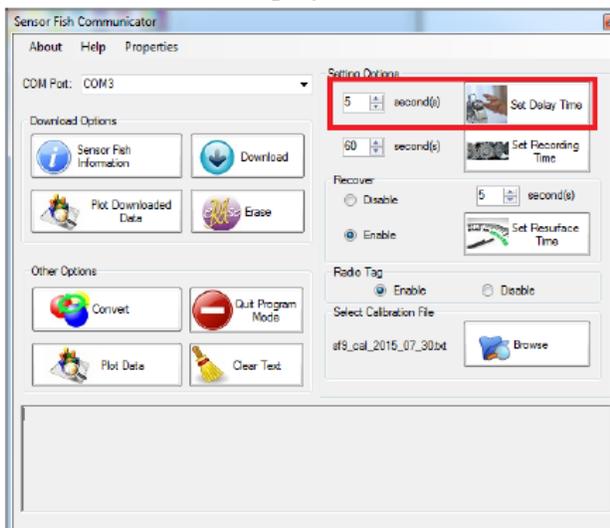
2.7   Setting the Record Time

The Recording Time is the period that Sensor Fish will collect data once the delay time has elapsed. The maximum collection time is 292 seconds; the default is 60 seconds. Using the selection menu, enter the desired recording time and click the "Set Recording Time" button. Once set, the selected time will be displayed in the text window.
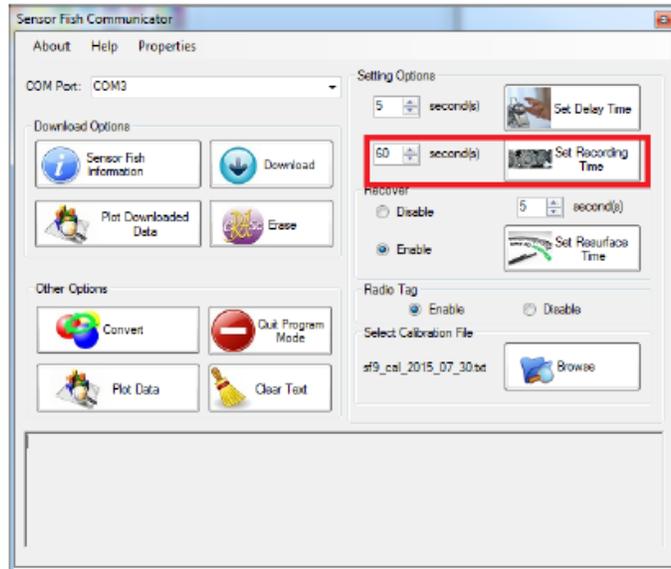
2.8   Setting the Resurface Time

The Resurface Time is the period between data recording and the start of resurfacing procedures. The maximum delay time is 900 seconds; the default is 5 seconds. Using the selection menu, enter the desired delay time and click the "Set Resurface Time" button. Once set, the selected time will be displayed in the text window.
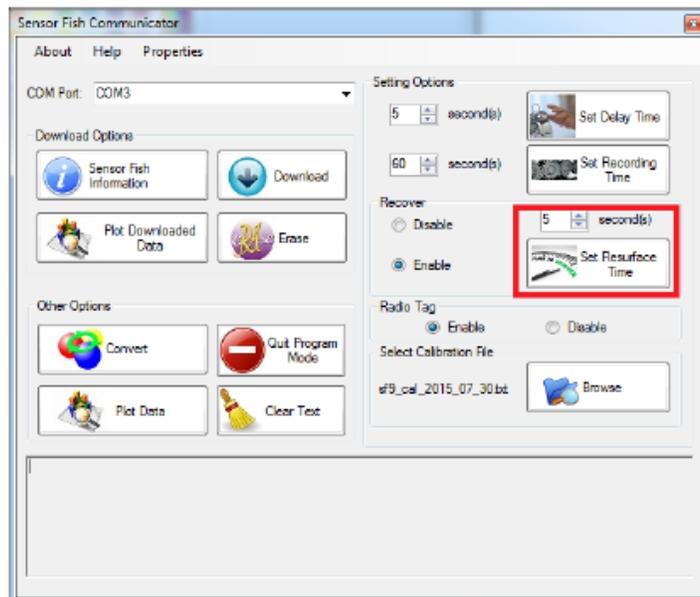
2.9 Setting the Radio Tag

The Sensor Fish has the capability to emit a radio frequency (RF) signal. If this function is preferred, select the "Enable" radio button; if not, select the "Disable" radio button. The status will be displayed in the text window.
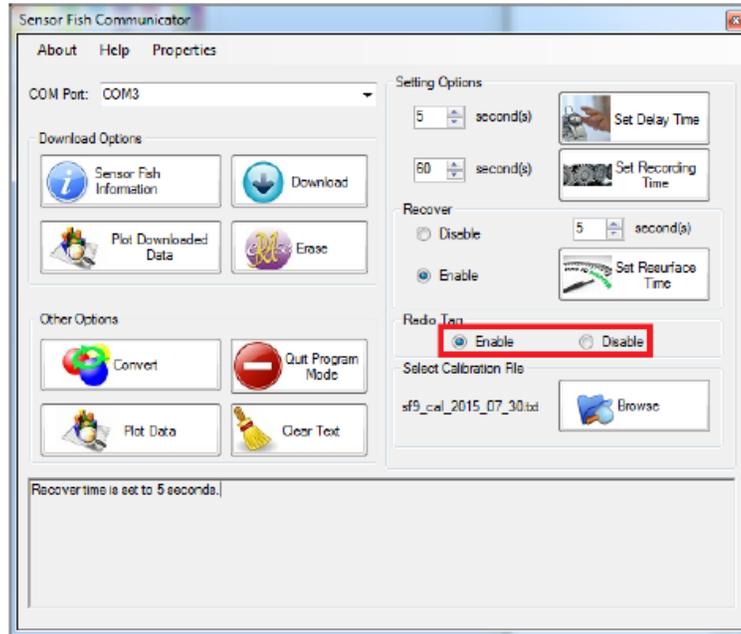
2.10 Quit Program Mode

After erasing the Sensor Fish data and entering the desired settings (described above), select the "Quit Program Mode" button to ready the Sensor Fish for data collection.

Note: The charge LED will remain red, even if the Sensor Fish has a full charge, until the unit exits Program Mode.
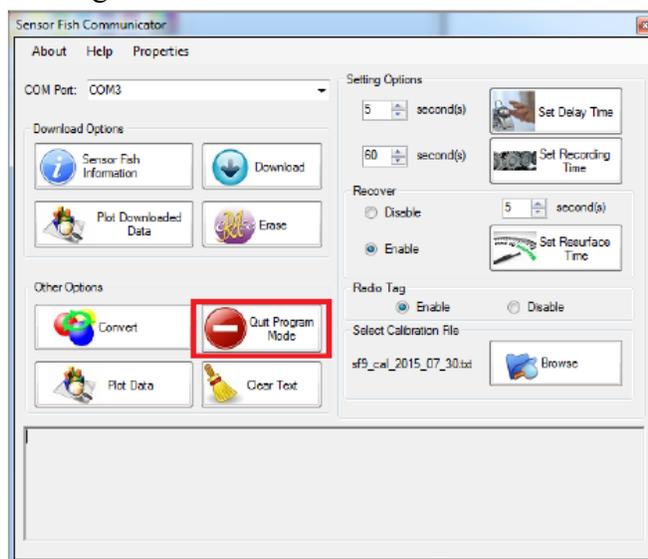
3.0 Sensor Fish Operation

3.1 LEDS

The Sensor Fish is equipped with Light Emitting Diodes (LED) which show the status of the Sensor Fish. When the Sensor Fish is connected to the Communicator program, a solid red light indicates the Sensor Fish is charging; when fully charged the LED is solid green (when not in Program Mode). The Sensor Fish is capable of deployment without a complete charge. Following data collection, the LEDs will emit flashing orange lights. If data has not been erased and the user attempts to activate the Sensor Fish the red LED will flash briefly, indicating the Sensor Fish will not accept new data. During activation, a red LED will flash, as described further in Section 3.2.
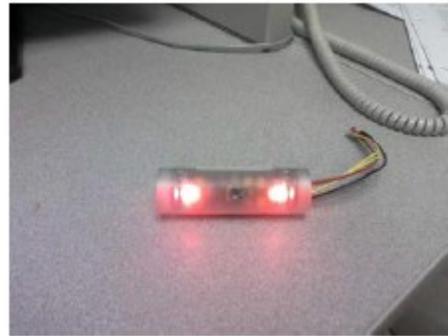
3.2 Activation

To begin the deployment process, a magnet is passed over the Hall sensor on the internal digital board to begin the activation process. The Hall sensor is located on the side opposite the pressure sensor. The red LED will blink once per second for the established delay time (Section 2.6). If Radio Tag is enabled, a RF signal will be emitted once per second, in sequence with the red LED. Once the delay time has elapsed, the unit will begin recording data. During the data collection period, no lights are visible and no RF signals are emitted.

Once the recording time has elapsed, the green LED will blink once per second during the preset resurface time (Section 2.8), after which the Sensor Fish will drop the weights and strobe. If the Radio Tag is enabled, the unit will also emit RF pulses, once every five seconds (every eight flashes). The weights drop sequentially, the lower one after 10 seconds, the upper one 10 seconds later. The Sensor Fish will then continue strobing with bright LEDS (and emitting pulses) until it is recovered and a magnet is passed over the Hall sensor, deactivating the unit.

In the event the Sensor Fish battery fully discharges after data collection but before download, the collection time will return to the default condition (60 seconds). When the unit is downloaded, only the first 60 seconds of the data will

transfer. To transfer the entire data set, the recording time must be set to the original collection time (Section 2.7) before downloading. Always confirm the data set is complete by plotting and viewing the data when downloading a Sensor Fish that was recovered with a dead battery. Also confirm the data is complete prior to erasing the Sensor Fish.

3.3 Replacing the Recovery Board Assemblies

When replacing the used Recovery Board Assemblies, it is important to remember that the two ends are different and cannot be interchanged. Recovery Board Assemblies with a red bead must be installed on the top end of the Sensor Fish, while assemblies with yellow beads are installed on the lower end. **Installing a recovery board onto the wrong end of the Sensor Fish could damage the connecting pins.**

Unscrew the endcap on the end of the Sensor Fish. Gently remove the Recovery Board Assembly by grasping the gray foam and pulling up, rocking it gently from side to side. Do not twist. When trying to remove the assembly after the weight has been dropped, the foam and spring may detach from the board. This is normal. Use a pair of tweezers or needle nose pliers to grasp the board by one of the small ringlets and gently pull it out, taking care not to damage the pins.


Visually line up the new Recovery Board Assembly with the pins on the Sensor Fish and carefully seat the Assembly. Use the transparent housing of the Sensor Fish to your advantage to look at the connections from the side and help align the pins with the sockets.

4.0 Processing the ARC800 Data

4.1 Downloading

Select the "Download" button to acquire the data from the Sensor Fish. After choosing a name for the file, the filename will have an underscore, the Sensor Fish serial number, an underscore, and the date in YYYYMMDDHHMMSS format automatically added, followed by the .raw2 file extension. For example, typing in "Turbine4" for the filename, on data from Sensor Fish 86, downloaded on October 14, 2018 at 10:11:12 AM, the file by default would be saved as Turbine4_0086_20181014101112.raw2.
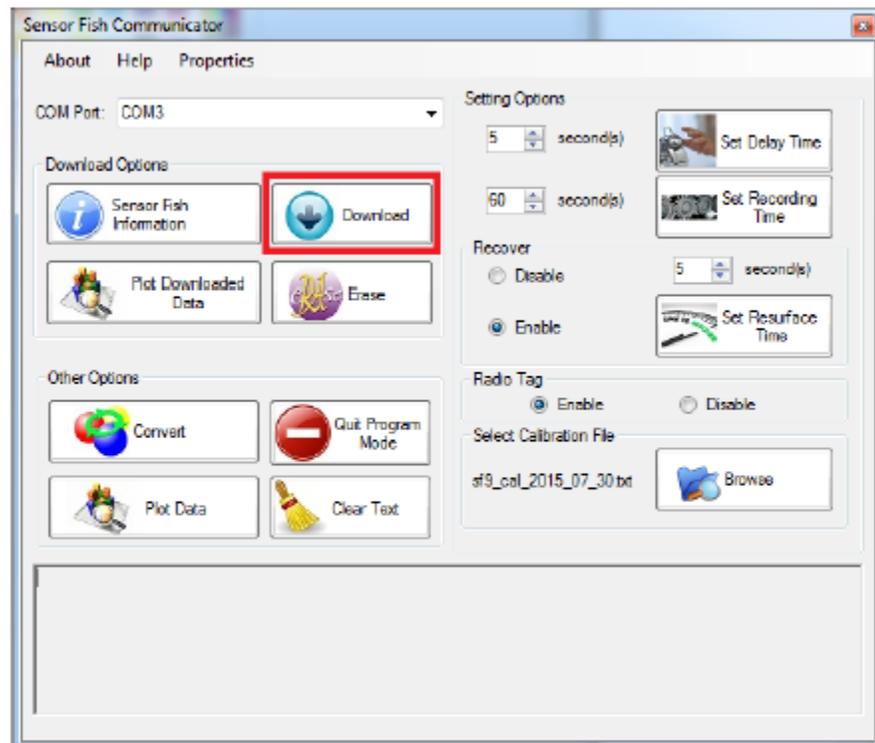
The downloading process may take several minutes, disabling the other functions in the Communicator until the task has completed. A status icon will be shown while downloading is proceeding and will disappear when the download is finished, restoring functionality to the Communicator window.

4.2 The Convert Feature

The Convert feature will transform an existing .raw2 data file to a .csv file. This can help recalibrate data that was downloaded with the wrong calibration file selected (See Section 6.0). Once the conversion is complete, the "Plot data" button can be used to graphically examine the data (See Section 4.4).
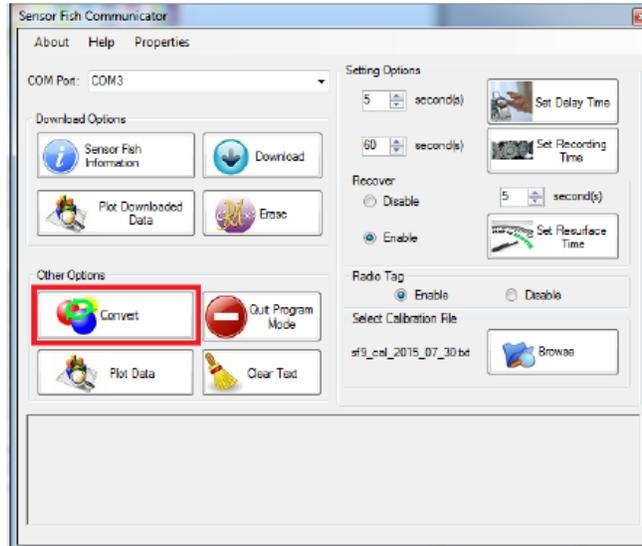
The conversion process may take several minutes, disabling the other functions in the Communicator until the task has completed. A status icon will be shown while downloading is proceeding and will disappear when the download is finished, restoring functionality to the Communicator window. A message will also be displayed in the text window to confirm the conversion has finished.

4.3 Clear Text

To clear the text window workspace, select the "Clear Text" button. This will remove the status updates.
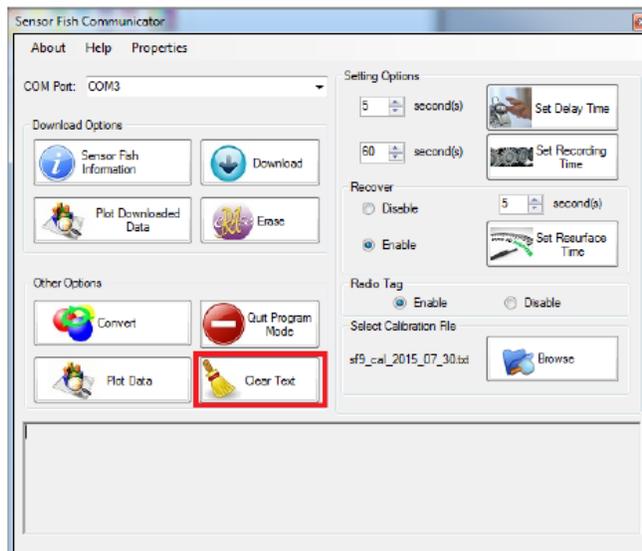
4.4 Plot Data

After Sensor Fish data has been downloaded, or after converting an existing .raw2 file the "Plot Data" button can be used to visually inspect the results in graphic format.
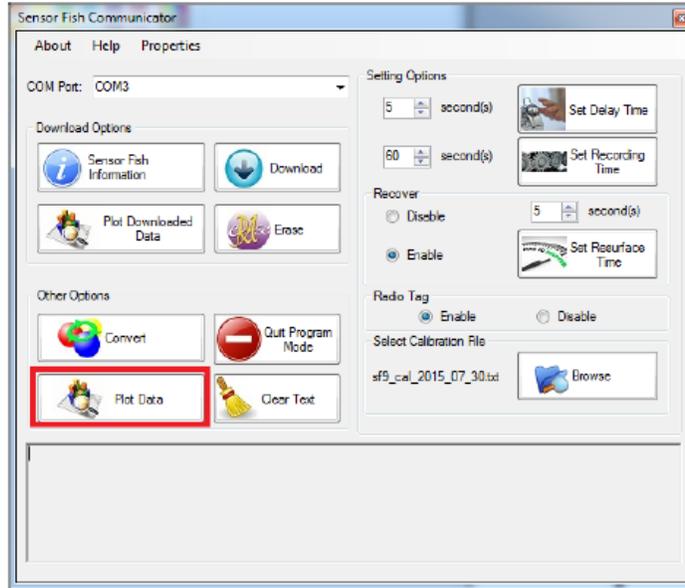
The graphics generated include the acceleration magnitude with pressure (upper plot) and rotation magnitude and pressure (lower plot). Dropdown menus and options on each side allow you to view different measurements at different scales with up to four different measurements being displayed at once.
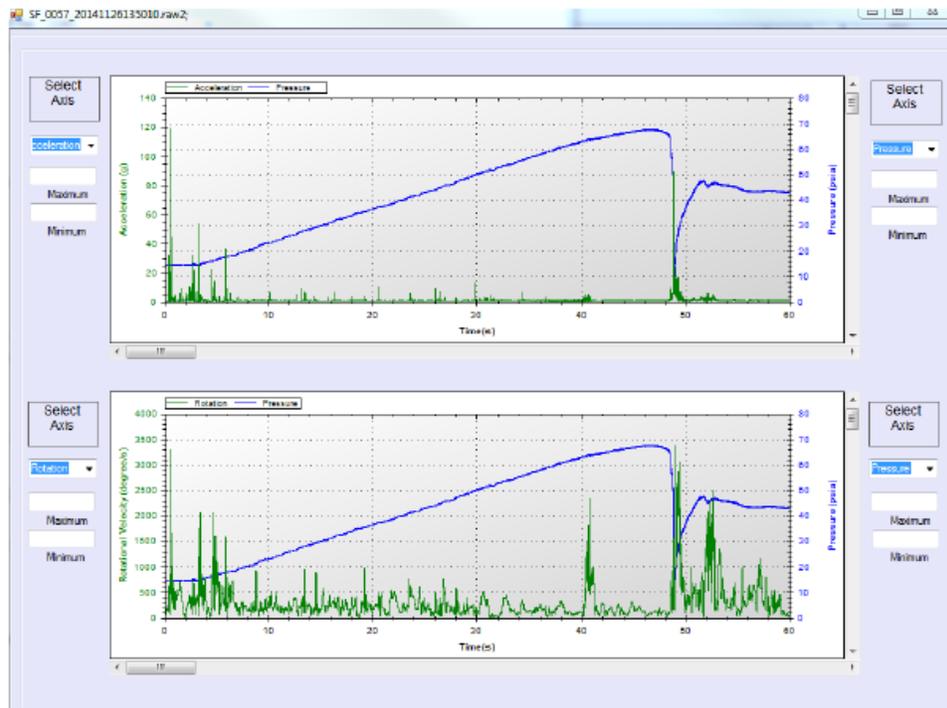
4.5 About

Selecting "About" on the menu bar reveals the software version information and disclaimer from the Contractor.

4.6 Help

The Help option is no longer supported by Windows. Selecting this may do nothing, but could result in an abnormal exit and require restarting the application.

5.0 Uninstall

To uninstall the Sensor Fish Communicator program, select the Windows Start button, go to the Control Panel, and select "Programs and Features." In the program list, navigate to and select "SFCommunicator," click "Uninstall," and follow the provided instructions. Once the uninstall has completed, a directory with a small number of files will remain in the installation location C:\Advanced Telemetry Systems, Inc\Sensor Fish Controller. These files amount to less than 3 Mb of space and may be deleted manually if the user wishes.

6.0 Calibration File Selection

The calibration file is a file customized for your particular Sensor Fish units and is selected by default. This text file contains all the information to calibrate the Sensor Fish download data, and **MUST NOT** be deleted or altered in any way. Do not change the calibration file selection unless instructed to do so by Advanced Telemetry Systems.

7.0 Sensor Fish LED Quick Reference Guide

PC CONNECTION

⬤ Charge LED   ⬤ Status

When the USB cable is connected to the Sensor Fish and a PC, two red LED's will illuminate. The red LED farthest from the USB cable connection is the Status LED. Once the USB cable is connected, the Status LED will stay illuminated red until the "Quit Program Mode" button is selected. Note: If the USB cable is disconnected without exiting Program Mode, the Status LED will remain red and the unit will not deploy. The PC connection can be re-established by reconnecting the USB cable.

CHARGING THE SENSOR FISH

⬤ Charging   🟢 Fully Charged

The red LED closest to the USB cable connection is the Charge LED. It illuminates RED when the Sensor Fish battery is charging. If the user selects "Quit Program Mode", then the Charge LED will turn green if/when a full charge level is reached. If the Sensor Fish is left in Program Mode, the Charge LED will remain red regardless of charge level, until the "Quit Program Mode" button is selected. Note: The Sensor Fish can be deployed without reaching a full charge (green).

ACTIVATION

⬤ Activating

The Sensor Fish will not activate if it is left in Programming Mode. It MUST be removed from Program Mode by selecting the "Quit Program Mode" option BEFORE disconnecting the USB cable, or activation will not occur. Reconnect the USB cable to exit Programming Mode.

The Sensor Fish will also not activate if it still contains data from a previous deployment. Instead, it will flash a red LED (once per second) for as long as the magnet is in close proximity to the Hall sensor. The Sensor Fish data will need to be erased before activation can occur.

To activate, pass a strong magnet over the Hall Sensor, which is opposite of the Pressure Sensor. The Status LED will flash orange once per second for the length of the delay time set (default five seconds).

RECORDING

During the set recording time, no LED's will illuminate.

RESURFACING

🟢 Resurfacing   🟠 Awaiting Recovery

Immediately prior to resurfacing, the Status LED will flash green, once per second, for the Set Resurface Time (Default five seconds). The ballast weights will then be released - one weight will be released immediately, followed by the second weight ten seconds later. After the second weight is released the Sensor Fish will flash four yellow LEDs (once per second) until either, a magnet passed over the Hall sensor, or the battery power expires. Once a magnet is used, the Sensor Fish LEDs will go dark and the unit is ready for downloading.

8.0 Addendums
8.1 Customer Refurbishment of Recovery Board Sets

**Things to keep in mind during refurbishment.**

The process of winding the fishing line around the Nikrothal heater wire is in a very small and confined space. It will require a really keen eye or some magnification to complete accurately.

The Nikrothal heater wire used on the recovery boards can pull out of the solder joints on the board if too much stress is put on it. It can also break off if bent repeatedly. Care must be used when winding the fishing line around the heater wire so as not to damage it or its connection to the board. If the wire is broken or pulled out, the wire will need to be repaired or the weight will not release.

The petroleum jelly used in the procedure helps prevent the thread from binding or knotting when it releases. It is a necessary part of the assembly and should not be overlooked.

The weight tying tool used to refurbish the Recovery boards should be used in conjunction with a blank endcap divider. NEVER use it to refurbish boards by screwing it onto the end of a Sensor Fish! The torque forces put on the board when twisting the tool down could easily bend or break off the pins on the Sensor Fish unit.

1. If the spring and foam insert are still attached to the board, carefully remove them and set them aside for reuse. If the spring is missing, it will need to be replaced with a new spring.
2. Carefully remove any residual fishing thread from the recovery board, taking care not to damage the Nikrothal heater wire. Inspect the board for damage and take note of which type of board is being refurbished (Download or Program). This will be needed later.
3. Cut a piece of white fishing line 15cm to 20cm in length.
4. Thread the fishing line.
   a. Thread one end of the fishing line through one of the two anchor rings until it is about halfway down the length of the fishing line.
   b. Wrap the line around the Nikrothal wire loop four times by crossing it under the wire five times.
   c. Thread the line out through the second anchor ring.
   d. Apply a small amount of petroleum jelly to the fishing line where it wraps around the Nikrothal wire. Use enough to coat all four windings.
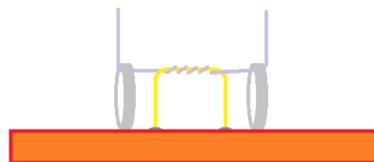
5. Thread the two loose ends of the fishing line up through the spring and fit the spring down over the two test lead connectors. It should snap lightly over the two rings so that it is held lightly in place.


6. Thread the two loose ends of the fishing line up through the foam insert and slide the insert down over the spring.
7. Thread the two loose ends of the fishing line up through the Tungsten weight. Make sure the flat side is down against the spring.
8. Place the assembly into the threaded side of the empty divider cap.

9. Thread the two loose ends of the fishing line through hole in the center of the weight tying tool.
10. Engage the threads of the weight tying tool with the threads of the empty divider cap and twist them together, taking up the slack in the fishing line. Verify that the Tungsten weight is centered under the hole of the tool.
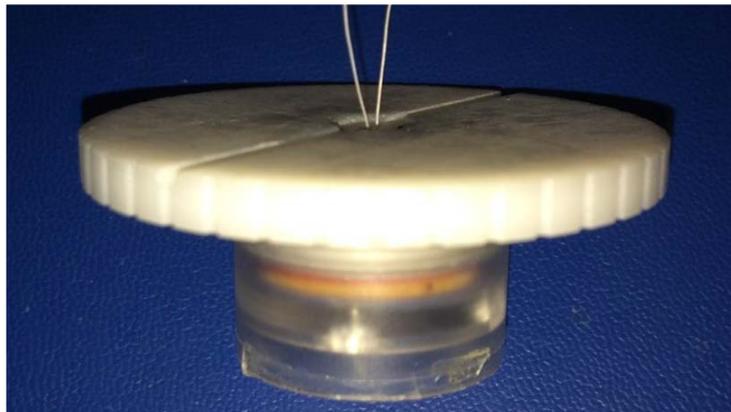
11. Using a gold bead for the Download board, or a silver-black bead for the Program board, thread a bead onto ONLY ONE of the two protruding threads.

12. Tug <u>gently</u> on the loose ends of the fishing line to ensure that they are fully extended out from inside the tying tool, then tie five overhand knots, pulling each knot gently tight before tying the next.
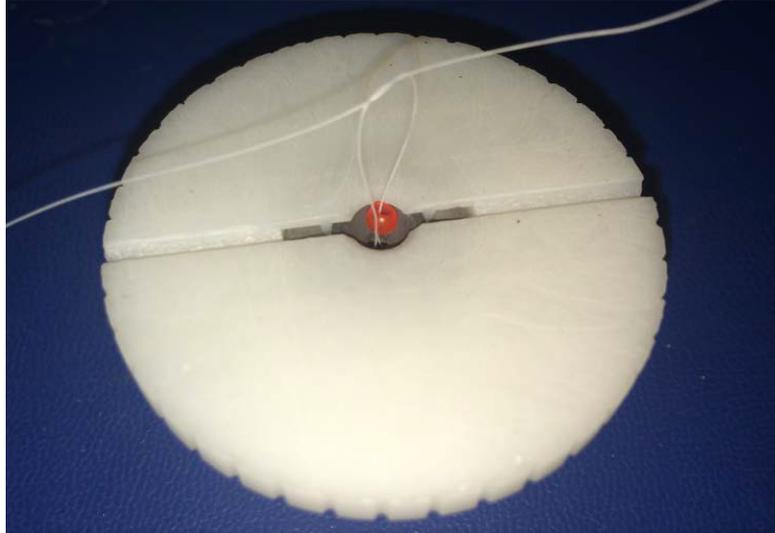
13. Slowly unscrew the tying tool from the divider cap and remove the recovery board.
14. Cut the fishing line off so that each end is 1-2cm long.
15. Inspect the finished recovery board unit. If the foam sits crooked or the weight appears loose, then the thread may be too loose and the process may need to be repeated.

16. If possible, use an ohm meter to measure continuity between the two points where the Nikrothal heater wire attaches to the board (This can be done from the bottom side of the board). If the two points measure open, then the Nikrothal heater wire is most likely damaged and the recovery board will need to be sent in to ATS for repair.

8.2 Balloon Float Assemblies (if equipped)

Please read through the entire process before deploying!

Note: PNNL recommends applying super glue to the balloon openings before using them. ATS does not perform this step because it cannot be anticipated how soon the balloons will be used and super glue can deteriorate the balloon material over time. Therefore, this step should not be done more than a few hours before using the balloon assemblies.

Apply a small amount of super glue along the inside of the balloon, between the balloon's surface and the top of the stopper. Use liquid super glue rather than the gel type so that it wicks around the inner circumference of the balloon opening better.

8.21 Balloon Attachment Procedure

1. Feed one end of the fishing line through one of the small holes in the cap and bring through the large hole in the center of the cap.
2. Tie the two ends of the fishing line together leaving about 0.5-1.0" between the top of the cap and the base of the balloon.
   a) Use 8 knots when tying the fishing line.
   b) Leave the extra fishing line attached as it doesn't hurt anything and cutting the extra too close to the knot can result in the knot coming undone.
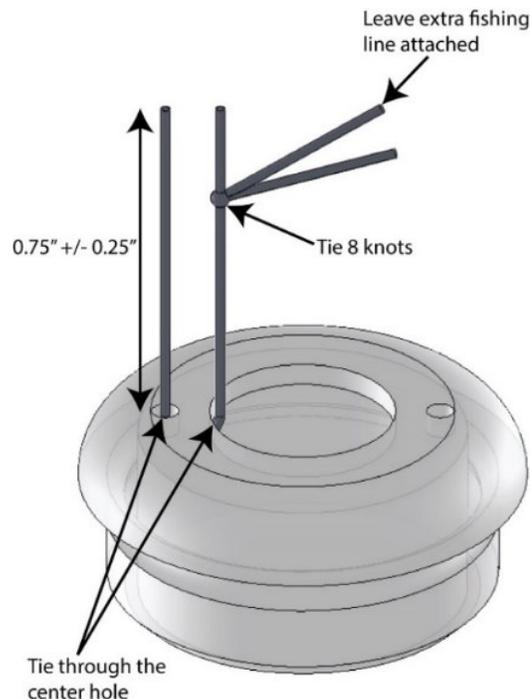
3. Test the knot by using your fingers to grab the fishing line on each side of the knot and pulling reasonably hard with your fingers. Don't pull by the balloon as you could accidently rip the fishing line through the rubber stopper.
4. Two balloons (one at each end of the sensor fish) are recommended.

8.22 Balloon Deployment Procedure

Note: Residual air inside the balloons as well as inside the endcaps can make the sensor fish reluctant to sink. Before completing step 4 and deploying the sensor fish, it may be a good idea to test the balloon/sensor fish assembly in water to make sure it is close to neutrally buoyant or even slightly negatively buoyant already. If not, a few wraps of electrical tape around the body of the sensor fish can add the additional weight needed to achieve this. Do not put the tape over the pressure sensor.

When ready to deploy, use the needle syringe to remove air and inject water into each balloon.

a) Insert the needle through the rubber stopper into the balloon's interior. Caution! The needle is sharp! Take care not to puncture fingers, the rubber balloon or pierce the capsules inside the balloon.
b) Pull back slightly on the plunger to remove as much of the air from inside the balloon as possible. Failure to do this may prevent the sensor fish from sinking. Also, keep in mind that the balloon will not collapse completely because of the capsules inside.
c) With the needle pointed down, inject water into the balloon. The amount of water injected varies between 1.5 and 10 mL, depending on the deployment conditions. Do not inject air into the balloon.
d) Repeat steps a-c with the second balloon.
e) Activate the sensor fish using a magnet and quickly deploy.

Things to remember

The sensor fish recovery boards with the tungsten weights must still be installed in order for the sensor fish to maintain a neutral buoyancy with the balloon floats attached. Enabling the release option to drop the weights after the recording time has elapsed is still an option, but the unit should surface with the balloons either way.
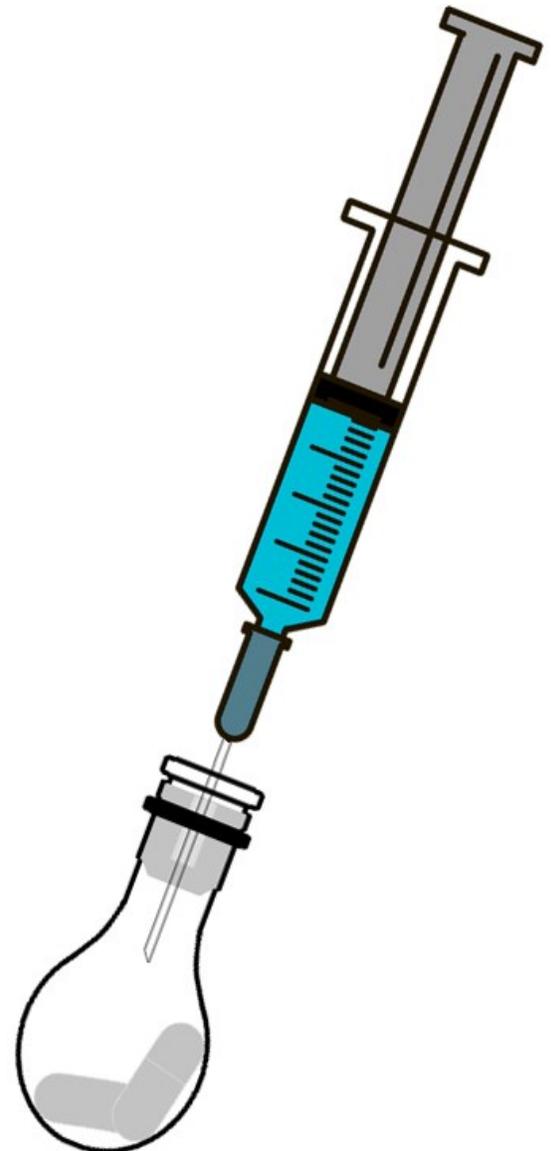
Once water is injected, the vegetable-based capsules begin dissolving. The more quickly the deployment can be completed, the more time the sensor fish will stay under before resurfacing.

The injected water amount and temperature will also impact how quickly the capsules inside the balloon dissolve and how fast the chemical reaction occurs. Generally speaking, colder water dissolves the capsules slower and warmer water dissolves them faster. A smaller amount of water may result in a less than complete chemical reaction and thus, less inflation, whereas more water allows for a full chemical reaction and more carbon dioxide to be produced, inflating the balloon more fully. Conditions can vary from one deployment location to another. It is therefore recommended that the user conduct controlled, test deployments to determine what water amount and temperature is best to use for the desired results.

Injecting water amounts in excess of about 3 mL will stretch or 'pre-inflate' the balloon with water. This should have no impact on the buoyancy, but it will increase the overall inflated diameter of the balloon.

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