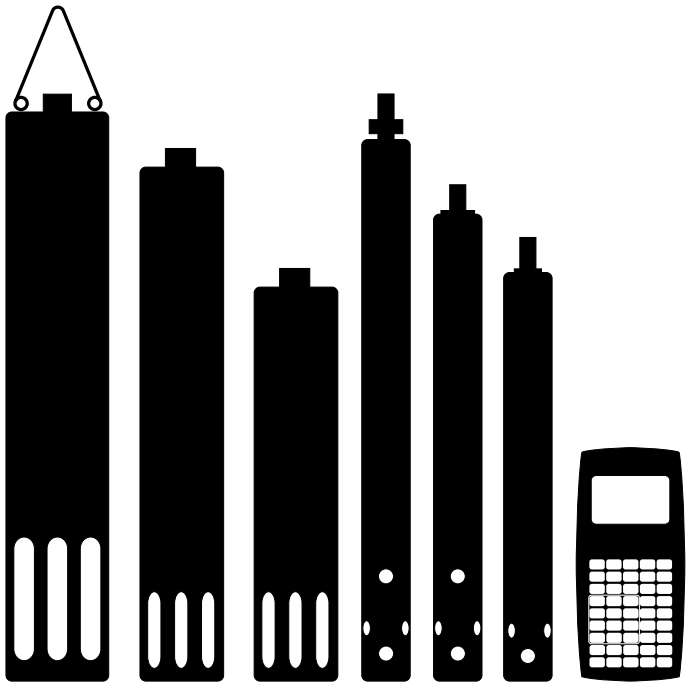
YSI *incorporated*



6-SERIES

6600 Sonde
6920 Sonde
6820 Sonde
600XLM Sonde
600XL Sonde
600R Sonde
610D Display/Logger
610DM Display/Logger

Environmental Monitoring Systems

SAFETY NOTES

TECHNICAL SUPPORT AND WARRANTY INFORMATION

Contact information for technical support and warranty information on YSI's Environmental Monitoring Systems products, can be found in **Section 8, Warranty and Service Information**.

COMPLIANCE

When using the YSI 6-Series sondes in a European Community (CE) country, please be aware that electromagnetic compatibility (EMC) performance issues may occur under certain conditions, such as when the sonde is exposed to certain radio frequency fields.

If you are concerned with these issues, consult the Declaration of Conformity that was enclosed with your instrument. Specific conditions where temporary sensor problems may occur are listed in this document.

If you are unable to locate the Declaration of Conformity that was shipped with your instrument, contact your local YSI representative, or YSI Customer Service in Yellow Springs, Ohio for a copy of the document. See **Section 8, Warranty and Service Information** for contact information.

SPECIFICATIONS

For general specifications for all YSI Environmental Monitoring Systems products included in this manual, please see **Appendix J, Specifications**.

GENERAL SAFETY CONSIDERATIONS

For Health and Safety issues concerning the use of the calibration solutions with the sondes, please see **Appendix A, Health and Safety**.

NOTICE

Information contained in this manual is subject to change without notice. Effort has been made to make the information contained in this manual complete, accurate, and current. YSI shall not be held responsible for errors or omissions in this operations manual.

WARNING:
When caring for your sonde, remember that the sonde is sealed at the factory, and there is never a need to gain access to the interior circuitry of the sonde. In fact, if you attempt to disassemble the sonde, you would void the manufacturer's warranty.

CONTENTS

SECTION 1 INTRODUCTION

1.1 ABOUT YSI INCORPORATED

From a three-man partnership in the basement of the Antioch College science building in 1948, YSI has grown into a commercial enterprise designing and manufacturing precision measurement sensors and control instruments for users around the world. Although our range of products is broad, we focus on four major markets: water testing and monitoring, health care, bioprocessing, and OEM temperature measurement.

In the 1950s, Hardy Trolander and David Case made the first practical electronic thermometer using a thermistor. This equipment was developed to supply Dr. Leland Clark with a highly sensitive and precise temperature sensor for the original heart-lung machine. The collaboration with Dr. Clark has been critical to the success of the company. In the 1960s, YSI refined a Clark invention, the membrane covered polarographic electrode, and commercialized oxygen sensors and meters which revolutionized the way dissolved oxygen was measured in wastewater treatment plants and environmental water. Today, geologists, biologists, environmental enforcement personnel, officials of water utilities and fish farmers recognize us as the leader in dissolved oxygen measurement.

In the 1970s, YSI again worked with Clark to commercialize one of his many inventions, the enzyme membrane. This development resulted in the first practical use of a biosensor, in the form of a membrane based on immobilized glucose oxidase, to measure blood sugar accurately and rapidly. In the next few years, this technology was extended to other enzymes, including lactate oxidase for applications in biotechnology, health care, and sports medicine.

In the early 1990s, YSI launched a line of multi-parameter water monitoring systems to address the emerging need to measure non-point source pollution. Today we have thousands of instruments in the field that operate with the push of a button, store data in memory, and communicate with computers. These instruments (described in this manual) are ideal for profiling and monitoring water conditions in industrial and wastewater effluents, lakes, rivers, wetlands, estuaries, coastal waters, and monitoring wells. If the instrument has ‘on board’ battery power, it can be left unattended for weeks at a time with measurement parameters sampled at your setup interval and data securely saved in the unit's internal memory. The fast response of YSI’s sensors make the systems ideal for vertical profiling, and the small size of some our sondes allows them to fit down 2-inch diameter monitoring wells. All of YSI’s multi-parameter systems feature the YSI-patented Rapid Pulse Dissolved Oxygen Sensor, which exhibits low-stirring dependence and provides accurate results without an expensive, bulky, and power-intensive stirrer.

YSI has established a worldwide network of selling partners in 54 countries that includes laboratory supply dealers, manufacturers' representatives, and YSI’s sales force. A subsidiary, YSI UK, distributes products in the United Kingdom, a sales office in Hong Kong supports YSI’s distribution partners in Asia Pacific, and YSI Japan supports distribution partners in Japan.

Through an employee stock ownership plan (ESOP), every employee is one of the owners. In 1994, the ESOP Association named YSI the ESOP Company of the Year. YSI is proud of its products and are committed to meeting or exceeding customers' expectations.

1.2 HOW TO USE THIS MANUAL

The manual is organized to let you quickly understand and operate the YSI 6-Series environmental monitoring systems. However, it cannot be stressed too strongly that informed and safe operation is more than just knowing which buttons to push. An understanding of the principles of operation, calibration techniques, and system setup is necessary to obtain accurate and meaningful results.

Because of the many features, configurations and applications of these versatile products, some sections of this manual may not apply to the specific system you have purchased.

If you have any questions about this product or its application, please contact YSI's customer service department or authorized dealer for assistance. See **Section 8, Warranty and Service Information** for contact information.

1.3 UNPACKING AND INSPECTION

Inspect the outside of the shipping box for damage. If any damage is detected, contact your shipping carrier immediately. Remove the equipment from the shipping box. Some parts or supplies are loose in the shipping box so check the packing material carefully. Check off all of the items on the packing list and inspect all of the assemblies and components for damage.

If any parts are damaged or missing, contact your YSI representative immediately. If you purchased the equipment directly from YSI, or if you do not know from which YSI representative your equipment was purchased, refer to **Section 8, Warranty and Service Information** for contact information.

SECTION 2 SONDES

2.1 GETTING STARTED

The 6-Series Environmental Monitoring Systems are multi-parameter, water quality measurement, and data collection systems. They are intended for use in research, assessment, and regulatory compliance applications. Section 2 concentrates on sondes and how to operate them during different applications. A sonde is a torpedo-shaped water quality monitoring device that is placed in the water to gather water quality data. Sondes may have multiple probes. Each probe may have one or more sensors that read water quality data.

The following list contains parameters that your sonde may measure. See **Appendix J, Specifications** for the specific parameters of each sonde.

- Dissolved Oxygen
- Conductivity
- Specific Conductance
- Salinity
- Total Dissolved Solids
- Resistivity
- Temperature
- pH
- ORP
- Depth
- Level
- Flow
- Turbidity
- Nitrate-N
- Ammonia-N
- Ammonium-N
- Chloride
- Chlorophyll

This section is designed to quickly familiarize you with the hardware and software components of the sondes and their accessories. You will then proceed to probe installations, cable connections, software installation and finally basic communication with your Sonde. Diagrams, menu flow charts and basic written instructions will guide you through basic hardware and software setup.

2.2 CONNECTING YOUR SONDE

There are a number of ways in which you may connect the sondes to various computers, data collection devices and VT-100 terminal emulators. To utilize the configuration that will work best for your application, make sure that you have all of the components that are necessary. The following list and diagrams (figures 1-4) are a few possible configurations.

- Sonde to Lab Computer (recommended for initial setup)
- Sonde to Data Collection Platform
- Sonde to Portable Computer
- Sonde to YSI 610 Display/Logger

Figure 1

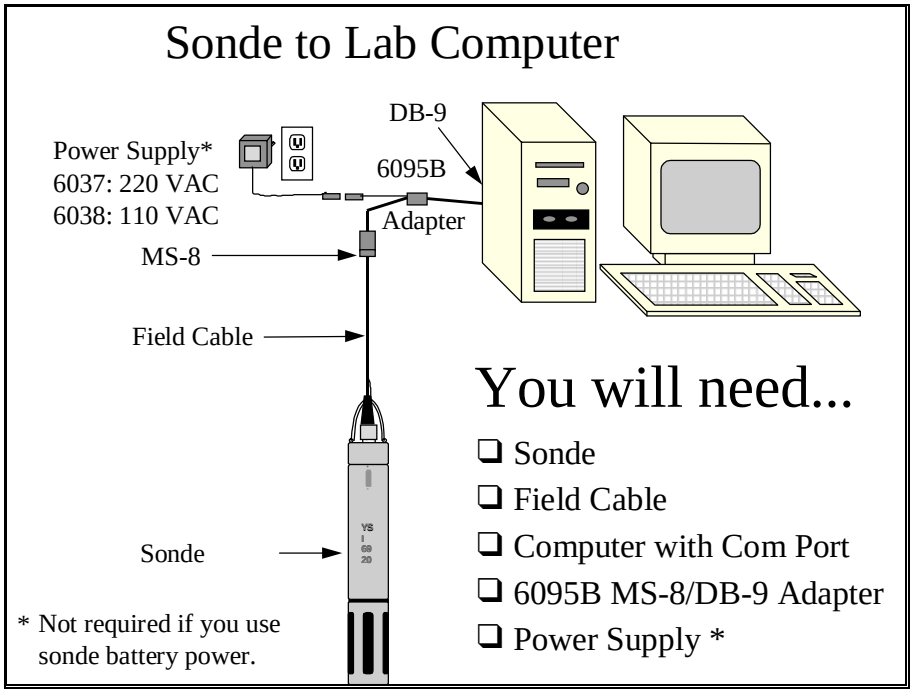


Figure 2

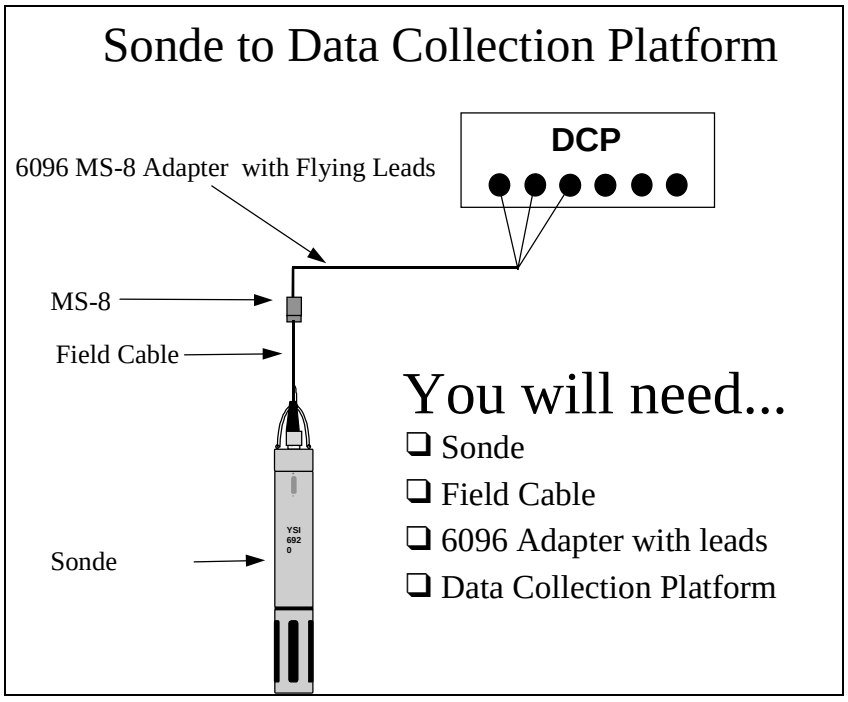


Figure 3

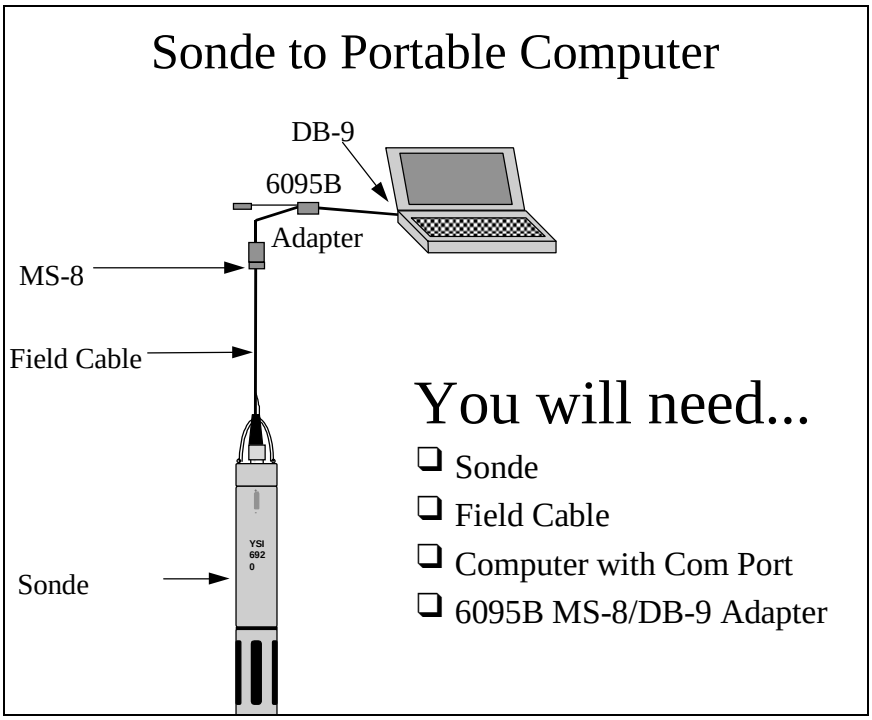
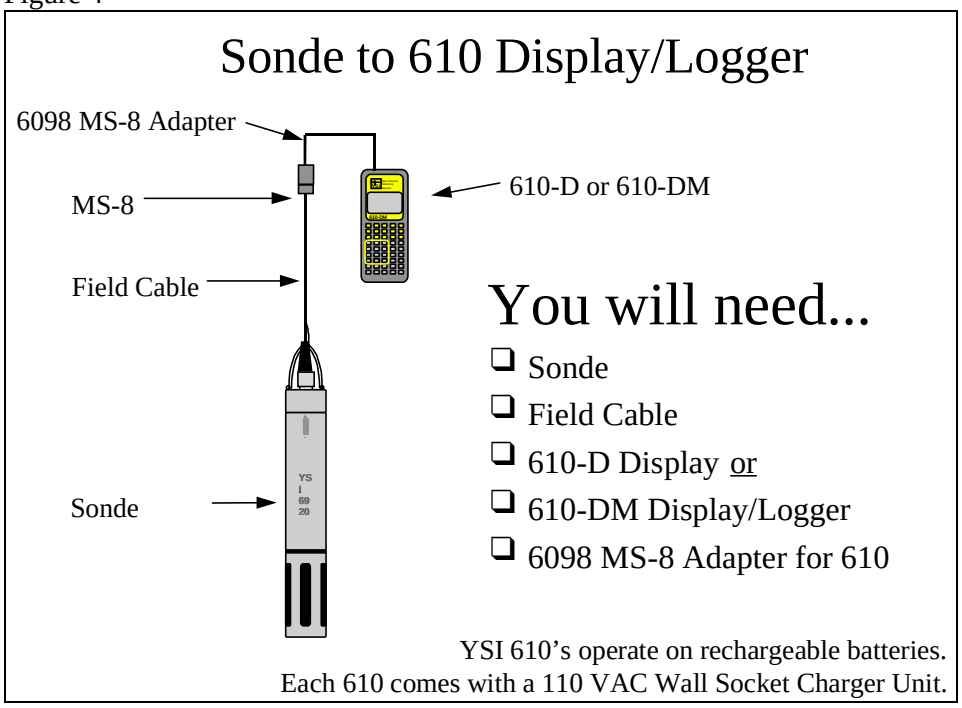


Figure 4


Sonde to 610 Display/Logger
6098 MS-8 Adapter
MS-8
Field Cable
Sonde
610-D or 610-DM
You will need...
Sonde
Field Cable
610-D Display or
610-DM Display/Logger
6098 MS-8 Adapter for 610
YSI 610's operate on rechargeable batteries.
Each 610 comes with a 110 VAC Wall Socket Charger Unit.

2.3 PREPARING THE SONDE FOR USE

To prepare the sonde for calibration and operation, you need to install probes (sensors) into the connectors on the sonde bulkhead. In addition to probe installation, you need to install a new membrane on the YSI 6562 DO Probe. It is recommended that you install the DO membrane before installing the probe onto the bulkhead. For membrane changes in the future, you may be able to perform this operation without removing the DO probe. This will largely depend on whether the other installed probes interfere with your ability to install a membrane. The next step is providing power for the sondes, through batteries or AC and then connecting a field cable. The four steps necessary for getting your sonde ready for use are listed below.

Step 1 Installing the Dissolved Oxygen Membrane – Section 2.3.1
Step 2 Installing the Probes – Section 2.3.2
Step 3 Power – Section 2.3.3
Step 4 Connecting a Field Cable – Section 2.3.4

2.3.1 STEP 1 - INSTALLING THE DISSOLVED OXYGEN MEMBRANE

The DO probe is shipped with a protective dry membrane on the sensor tip, held in place by an O-ring. Remove the O-ring and membrane. Handle the probe with care. It is very important not to scratch or contaminate the sensor tip. See **Section 2.10.2, Probe Care and Maintenance**, for information on how often the membrane should be replaced.

Unpack the YSI 6562 DO Probe Kit and follow the instructions below.

1. Open the membrane kit and prepare the electrolyte solution. Dissolve the KCl in the dropper bottle by filling it to the neck with deionized or distilled water and shaking until the solids are fully dissolved. After the KCl is dissolved, wait a few minutes until the solution is free of bubbles.

Figure 5

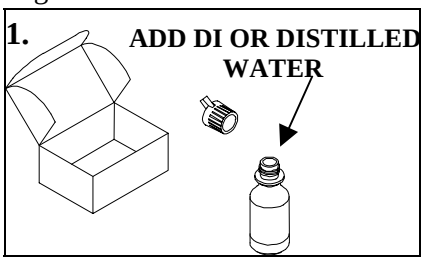
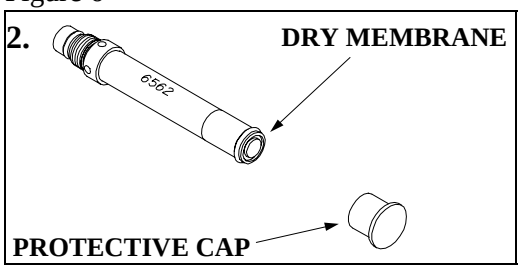


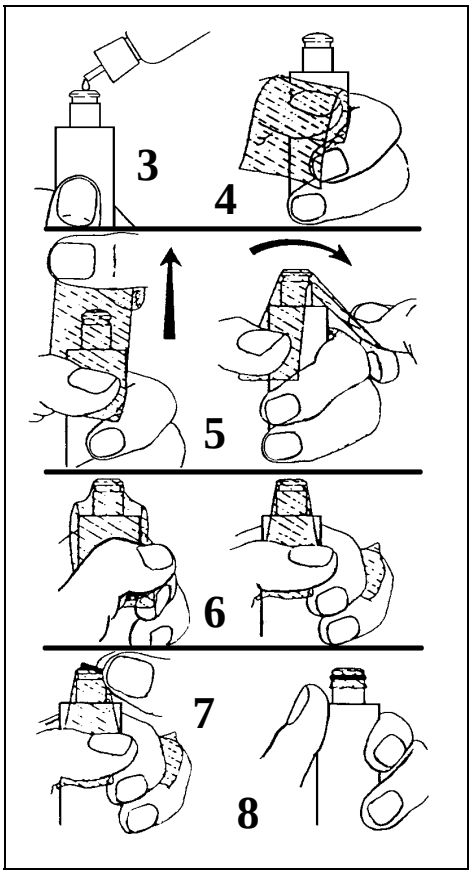
Figure 6



2. Remove the protective cap and the dry membrane from the YSI 6562 Dissolved Oxygen probe.

3. Hold the probe in a vertical position and apply a few drops of KCl solution to the tip. The fluid should completely fill the small moat around the electrodes and form a meniscus on the tip of the sensor. Be sure no air bubbles are stuck to the face of the sensor. If necessary, shake off the electrolyte and start over.

Figure 7



4. Secure a membrane between your left thumb and the probe body. Always handle the membrane with care, touching it only at the ends.

5. With the thumb and forefinger of your right hand, grasp the free end of the membrane. With one continuous motion, gently stretch it up, over, and down the other side of the sensor. The membrane should conform to the face of the sensor.

6. Secure the end of the membrane under the forefinger of your left hand.

7. Roll the O-ring over the end of the probe, being careful not to touch the membrane surface with your fingers. There should be no wrinkles or trapped air bubbles. Small wrinkles may be removed by lightly tugging on the edges of the membrane. If bubbles are present, remove the membrane and repeat steps 3-8.

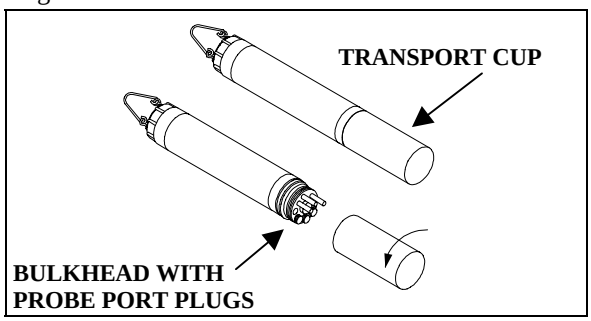
8. Trim off any excess membrane with a sharp knife or scissors. Rinse off any excess KCl solution, but be careful not to get any water in the connector.

TIP: You may find it more convenient to mount the probe vertically in a vise with rubber jaws while applying the electrolyte and membrane to the sensor tip.

2.3.2 STEP 2 - INSTALLING THE PROBES

Remove the calibration cup from your sonde by hand as shown in figure 8, to expose the bulkhead.

Figure 8



REMOVING THE PORT PLUGS

Using the probe installation tools that are supplied in the YSI #6570 Maintenance Kit, remove the port plugs. Save all the port plugs for possible future use.

There are a variety of probe options for the sondes. Figures 9, 10 and 11 illustrate various tools that are used for port plug removal. Some of these tools may also be used to install the various probes.

In place of the small tool provided port plug removal, you may use a 7/64" hex key.

Figure 9

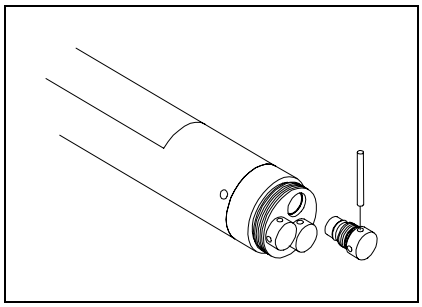


Figure 10

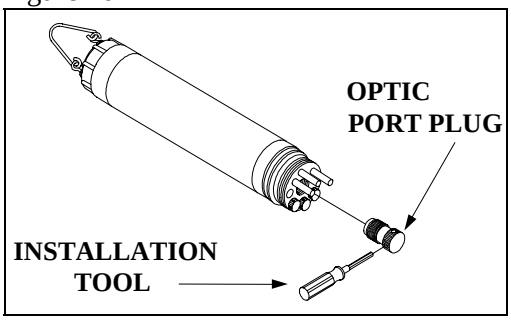
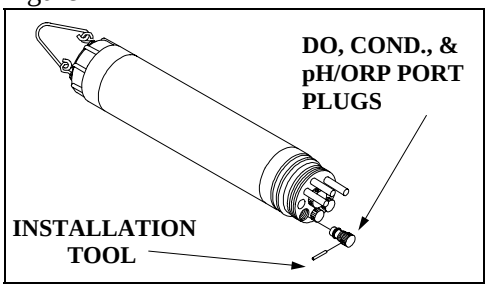


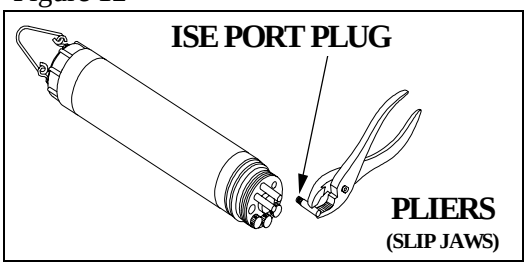
Figure 11



NOTE: You may need pliers to remove the ISE port plugs, but do not use pliers to tighten the ISE probes. Hand-tighten only.

Now refer to figures 13, 14, 15 and 16 to find the probe locations in your sonde.

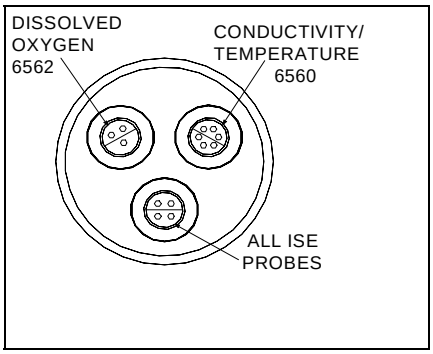
Figure 12



600XL & 600XLM SONDE BULKHEAD

- 6562 Dissolved oxygen probe = 3-pin connector
- 6560 Conductivity/Temperature = 6-pin connector
- 6561 pH probe = 4 pin connector
- 6565 Combo pH/ORP probe = 4 pin connector

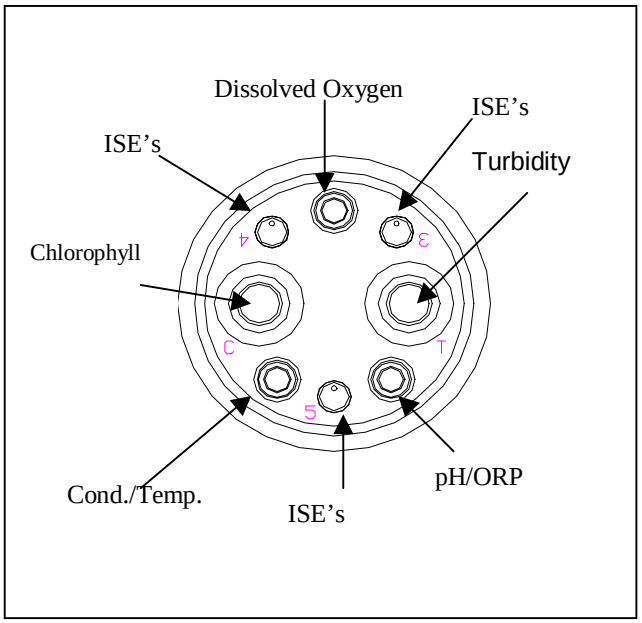
Figure 13



6600 SONDE BULKHEAD

- 6562 Dissolved oxygen probe = 3-pin connector
- 6560 Conductivity/Temperature = 6-pin connector
- 6561 pH probe = 4 pin connector
- 6565 Combination pH/ORP probe = 4 pin connector
- 6882 Chloride Probe = leaf spring connector
- 6883 Ammonium Probe = leaf spring connector
- 6884 Nitrate Probe = leaf spring connector
- 6036 Turbidity Probe, Non-wiping = 8 pin connector
- 6026 Turbidity Probe, Wiping = 8 pin connector
- 6025 Chlorophyll Probe, Wiping = 8 pin connector

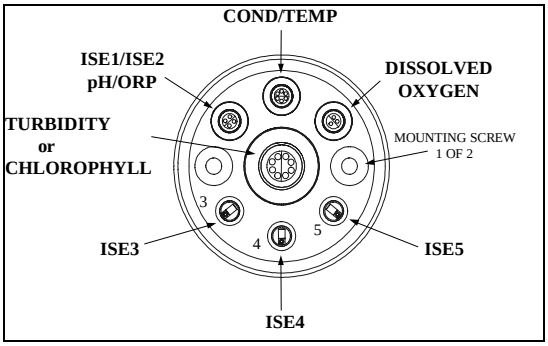
Figure 14



6820 & 6920 SONDE BULKHEAD

- 6562 Dissolved oxygen probe = 3-pin connector
- 6560 Conductivity/Temperature = 6-pin connector
- 6561 pH probe = 4 pin connector
- 6565 Combination pH/ORP probe = 4 pin connector
- 6882 Chloride Probe = leaf spring connector
- 6883 Ammonium Probe = leaf spring connector
- 6884 Nitrate Probe = leaf spring connector
- 6036 Turbidity Probe, Non-wiping = 8 pin connector
- 6026 Turbidity Probe, Wiping = 8 pin connector
- 6025 Chlorophyll Probe, Wiping = 8 pin connector

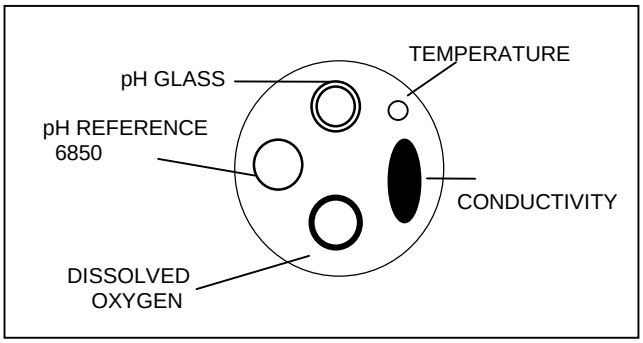
Figure 15



600R BULKHEAD

If are working with a 600R sonde, your instrument will arrive with the probes installed.

Figure 16

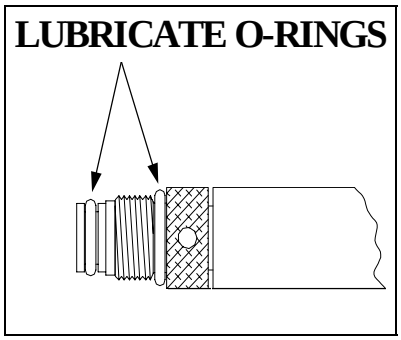


LUBRICATE O-RINGS

Apply a thin coat of O-ring lubricant, supplied in the YSI 6570 Maintenance Kit, to the O-rings on the connector side of each probes that is to be installed.

CAUTION: **Make sure that there are NO contaminants between the O-ring and the probe. Contaminants that are present under the O-ring may cause the O-ring to leak when the sonde is deployed.**

Figure 17

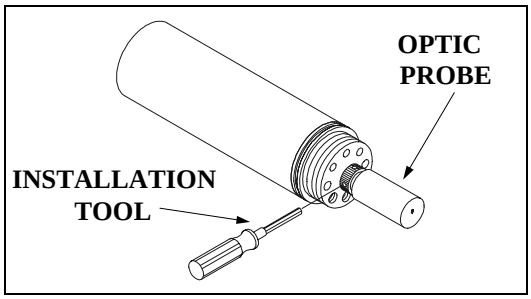


NOTE: **Before installing any probe into the sonde bulkhead, be sure that the probe port is free of moisture. If there is moisture present, you may use a can of compressed air to blow out the remaining moisture.**

INSTALLING THE TURBIDITY OR CHLOROPHYLL PROBE

If you have either a turbidity or chlorophyll probe, it is recommended that it is installed first due to its center position in the sonde bulkhead. If you are not installing one of these probes, do not remove the port plug, and go on to the next probe installation.

Figure 18



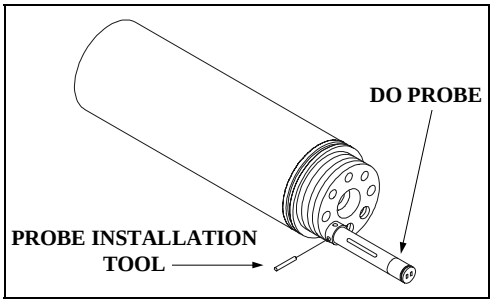
All optic probes, YSI 6026 wiping turbidity, 6036 non-wiping turbidity, and 6025 chlorophyll, are installed in the same way. Install the probe into the center port, seating the pins of the two connectors before you begin to tighten. Tighten the probe nut to the bulkhead using the installation tool supplied with the probe. Do not over-tighten.

CAUTION: Be careful not to cross-thread the probe nut.

The YSI 6820 and 6920 sondes can accept either a turbidity or chlorophyll probe. The 6600 sonde can accept and utilize both chlorophyll and turbidity at the same time. When installing both probes in a 6600 sonde, install the turbidity probe in the port marked “T” and the chlorophyll probe in the port marked “C”.

INSTALLING THE DISSOLVED OXYGEN PROBE, CONDUCTIVITY/TEMP AND pH/ORP PROBES

Figure 19



Insert the probe into the correct port and gently rotate the probe until the two connectors align.

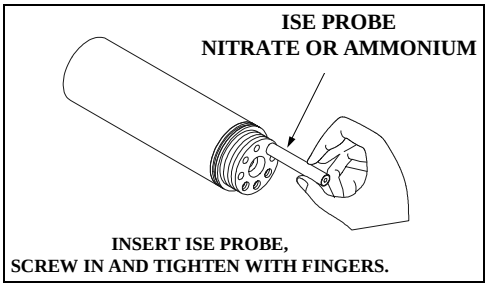
The probes have slip nuts that require a small probe installation tool to tighten the probe. With the connectors aligned, screw down the probe nut using the probe installation tool. Do not over-tighten.

CAUTION: Do not to cross thread the probe nut.

INSTALLING THE ISE PROBES

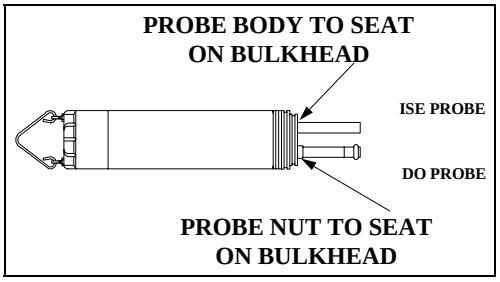
The Ammonium, Nitrate and Chloride ISE probes do not have slip nuts and should be installed without tools. Use only your fingers to tighten.

Figure 20



IMPORTANT: Make sure that the probe nut or probe body of the ISE probes are seated directly on the Sonde Bulkhead. This will ensure that connector seals will not allow leakage.

Figure 21



INSTALLING THE PROBE GUARD

Included with each sonde is a probe guard. The probe guard protects the probes during calibration and measurement procedures. Once the probes are installed, install this guard by aligning it with the threads on the bulkhead and turn the guard clockwise until secure.

CAUTION: Be careful not to damage the DO membrane during installation of the probe guard.

Figure 22 shows the YSI 6820, 6600 and 6920 probe guards. The YSI 600R, 600XL and 600XLM probe guards resemble Figure 23.

Figure 22

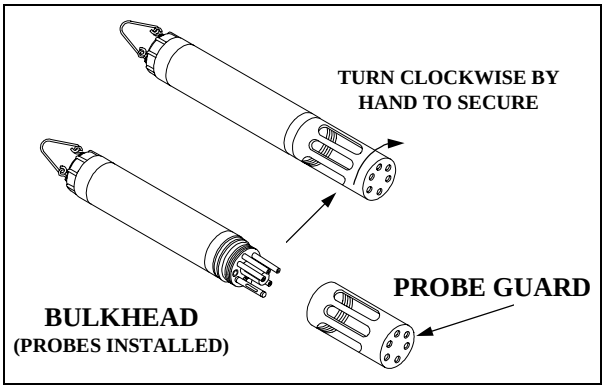
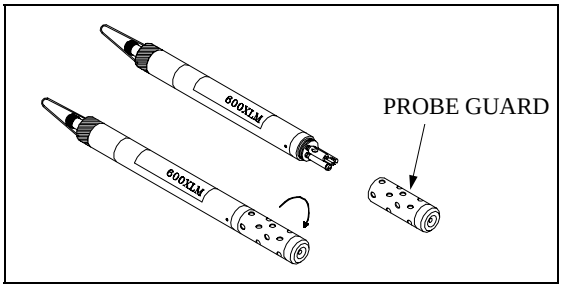


Figure 23



2.3.3 STEP 3 - POWER

Some type of external power supply is required to power the YSI 600R, 600XL and 6820 sondes. The YSI 6920, 6600 and 600XLM sondes have internal batteries or can run on external power.

If you have purchased a YSI 610 or 610DM display/logger, attaching your sonde to the display/logger will allow your sonde to be powered from the batteries or external power of the display/logger. See **Section 3, Displays/Loggers,** for power options.

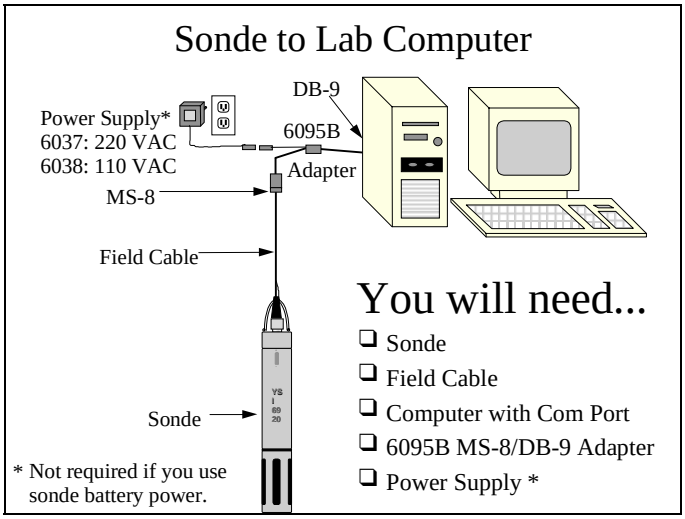
POWER FOR LAB CALIBRATION

A YSI 6038 (110 VAC) or 6037 (220 VAC) Power Supply is required for sondes without internal batteries when using them with a PC for calibration and setup. Sondes with internal batteries do not require a power supply, but using the sonde with a power supply in the lab is often convenient and extends battery life. Most adapters include a short pigtail for power that plugs into the power supply. After attaching the four-pin connector from the power supply to the pigtail, simply plug the power supply into the appropriate AC outlet.

See **Section 2.2, Connecting Your Sonde**, for specific information on cables, adapters and power supplies required for connecting your sonde to various devices.

The system configuration best suited for initial setup is shown in figure 24.

Figure 24

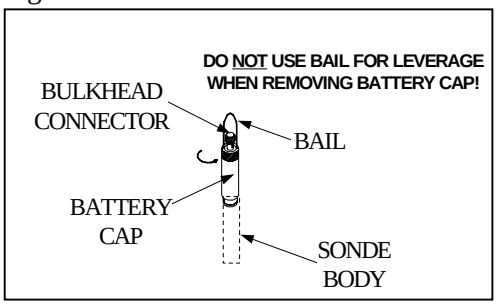


INSTALLING BATTERIES

The 600XLM, 6600 and the 6920 are the only sondes that use alkaline batteries for power. If you do not have one of these sonde model types, you may skip this section.

INSTALLING BATTERIES INTO THE YSI 600XLM

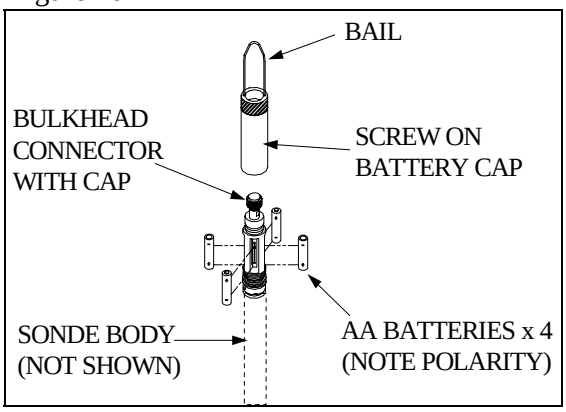
Figure 25



Your first set of batteries are supplied with the instrument. To install 4 AA-size alkaline batteries into the sonde, refer to the following directions and figure 25.

Grasp the cylindrical battery cover and unscrew by hand. Then slide the battery lid up and over the bulkhead connector. Insert batteries, paying special attention to polarity. Labeling on the battery compartment posts describes the orientation. It is usually easiest to insert the negative end of battery first and then "pop" the positive terminal into place.

Figure 26



Check the O-ring and sealing surfaces for any contaminants that could interfere with the O-ring seal of the battery chamber.

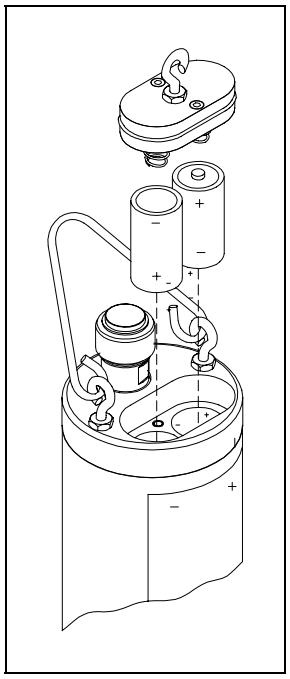
CAUTION: **Make sure that there are NO contaminants between the O-ring and the sonde. Contaminants that are present under the O-ring may cause the O-ring to leak when the sonde is deployed.**

Lightly lubricate the o-ring on the outside of the battery cover. DO NOT lubricate the internal o-ring.

Return the battery lid and tighten by hand.
DO NOT OVER-TIGHTEN.

INSTALLING BATTERIES INTO THE YSI 6600

Figure 27



Your first set of are supplied with the instrument. Install 8 C-size alkaline batteries according to the following directions and figure 27.

Using the hex driver, supplied in the 6570 Maintenance Kit, loosen the battery lid screws.

NOTE: The battery lid screws are captive. It is not necessary to remove them from the lid completely.

Remove the battery lid and install the batteries, as shown. Observe the correct polarity before installing the batteries into the battery chamber.

***CAUTION*: Be sure the bottom O-ring is installed in the groove of the lid. Check the O-ring and sealing surfaces for any contaminates which could interfere with the O-ring seal of the battery chamber. Remove any contaminates present. Also clean the protective O-ring which is located in the middle of the side of the battery lid.**

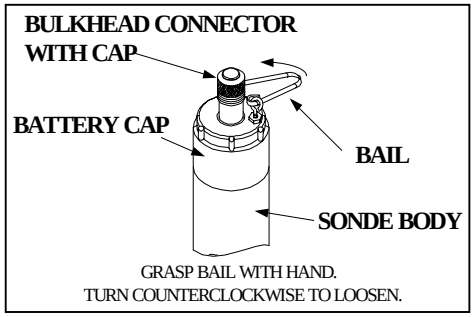
Lightly lubricate the o-ring on the outside of the battery cover. DO NOT lubricate the internal o-ring.

Return the battery lid and HAND tighten the screws until snug. *DO NOT OVER TIGHTEN.*

***CAUTION*: Over-tightening the screws may cause the battery compartment to flood.**

INSTALLING BATTERIES INTO THE 6920

Figure 28

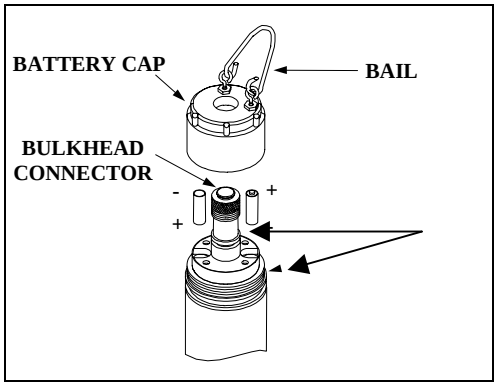


Your first set of batteries are supplied with the instrument. To install the 8 AA-size alkaline batteries into the sonde, refer to the following directions and figures 28 and 29.

Position the bail so that it is perpendicular to the sonde and use it as a lever to unscrew the battery cap by hand. Then slide the battery lid up and over the bulkhead connector.

Insert batteries, paying special attention to polarity. Labeling on the sonde body describes the orientation.

Figure 29



Check the O-ring and sealing surfaces for any contaminants that could interfere with the O-ring seal of the battery chamber.

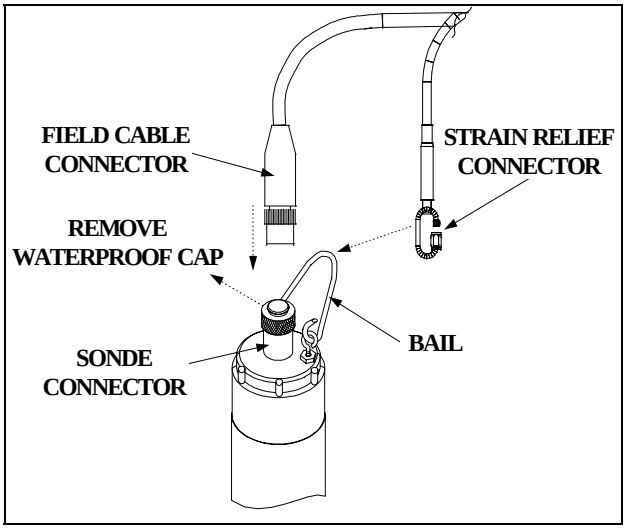
CAUTION: **Make sure that there are NO contaminants between the O-ring and the probe. Contaminants that are present under the O-ring may cause the O-ring to leak when the sonde is deployed.**

Lightly lubricate the o-ring on the outside of the battery cover. DO NOT lubricate the internal o-ring.

Return the battery lid and tighten by hand. *DO NOT OVER-TIGHTEN.*

2.3.4 STEP 4 - CONNECTING A FIELD CABLE

Figure 30



The YSI 6600, 6920 and 600XLM sondes have a sonde-mounted cable connector for attachment of the field cable.

Some versions of the YSI 600R, 600XLM and 6820 sondes have permanently attached “integral” cables. If your sonde has a cable that is non-detachable, parts of the next paragraph will not be relevant.

To attach a field cable to the sonde connector, remove the waterproof cap (provided with sondes with logging capability or vented level) from the sonde connector and set it aside for later reassembly during deployment or storage. Then connect your field cable to the sonde

connector.
A built-in “key” will ensure proper pin alignment. Rotate the cable gently until the “key” engages and then tighten the connectors together by rotating clockwise. Attach the strain relief connector to the sonde bail. Rotate the strain relief connector nut to close the connector's opening.

For all of the sondes, the other end of the cable is a military-style 8-pin connector (MS-8). Through use of a YSI 6095B MS-8 to DB-9 adapter, the sonde may be connected to a computer for setup, calibration, real-time measurement, and uploading files.

This MS-8 connector also plugs directly into the 610-D or 610-DM display/loggers. The displays and loggers are microcomputers and can be used in a similar manner to that of EcoWatch on a PC.

As an alternative to the field cable, you may use a YSI 6067B calibration cable for laboratory interaction with the sonde. In this case, simply plug the proper end of the cable into the sonde connector and attach the DB-9 connector of the cable to the Com port of your computer. This cable is for laboratory use only -- it is not waterproof and should not be submersed!

Sondes that are equipped with level sensors use vented cables. See **Appendix G, Using Vented Level**, for detailed information.

2.4 ECOWATCH FOR WINDOWS -GETTING STARTED

There are two different types of computer software that may be used with YSI's environmental monitoring systems. EcoWatch for Windows, which may be used with Windows 3.1 and higher or PC6000, which is a DOS-based system. See **Appendix C, Accessories and Calibration Standards** for ordering information. Information on how to use PC6000 is provided with the software.

This section will describe how to get started with EcoWatch for Windows, but detailed information is provided in **Section 4, EcoWatch for Windows**, or a convenient Windows Help section. It is recommended that you thoroughly read Section 4 or use the Help function for a comprehensive understanding of EcoWatch for Windows.

2.4.1 INSTALLING ECOWATCH FOR WINDOWS

EcoWatch for Windows software must be used with an IBM-compatible PC with a 386 (or better) processor. The computer should also have at least 4MB of RAM and Windows Version 3.1 or later.

Place Disk 1 of EcoWatch for Windows in your 3.5 inch floppy disk drive, and select Run and type "**a:\setup.exe**" at the prompt. Press **Enter** or click on "**OK**" and the display will indicate that EcoWatch is proceeding with the setup routine. Simply follow the instructions on the screen after installation is complete.

2.4.2 RUNNING ECOWATCH FOR WINDOWS

To run EcoWatch for Windows, simply select the EcoWatch icon on your desktop or from the Windows Program Menu. For help with the EcoWatch program, see **Section 4, EcoWatch** or use the Help section of the software.

2.4.3 ECOWATCH FOR WINDOWS SETUP

To setup the EcoWatch software for use with a sonde, select the sonde icon  on the toolbar, and then the **proper** Com port (1 or 2) to which your sonde is connected. If the default setting is correct, it does not need to be changed. Click "**OK**" to open a terminal window.

From the **Comm** Menu, select the **Settings** option to check the baud rate. The baud rate should be 9600. If it is not, select 9600 from the list and press **Enter**.

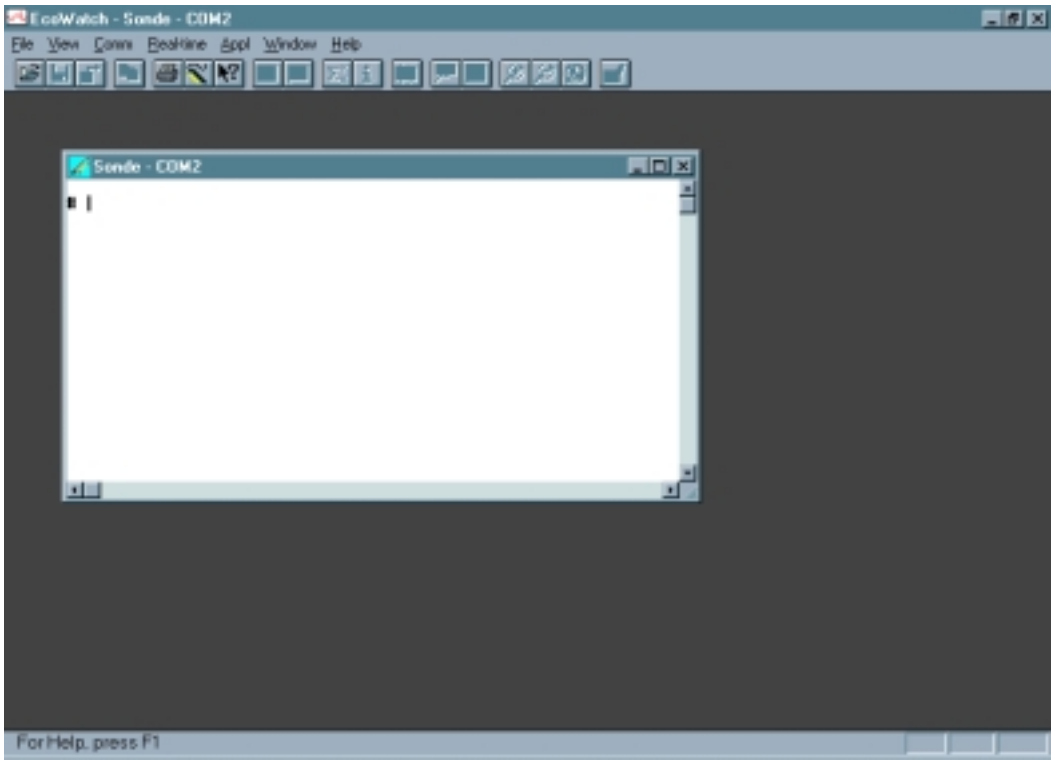
From the **Settings** Menu, select the **Font/Color** and **Background Color** options to choose a color scheme for the EcoWatch for Windows menus.

To select the printer that you wish to use, from the **File** menu, select **Print Setup** to specify the parallel port (LPT1, LPT2 or LPT3) to which your printer is connected. If no printer is connected, select LPT1.

2.5 SONDE SOFTWARE SETUP

There are two sets of software at work within the sonde configuration. One is resident in your PC and is called EcoWatch for Windows. The other software is resident in the sonde itself. When you select **Sonde** from the EcoWatch for Windows menus, the PC-based software begins direct communication with the sonde-based software via standard VT100 terminal emulation.

In EcoWatch for Windows, select the sonde icon,  then select the proper Com port and confirm by clicking **OK**. A window similar to that shown below will appear indicating connection to the sonde. Type "**Menu**" after the **#** sign, press **Enter**, and the sonde Main menu will be displayed.



If your sonde has previously been used, the **Main menu** (rather than the # sign) may appear when communication is established. In this case simply proceed as described below. You will not be required to type "**Menu**".

If you are unable to establish interaction with the sonde, make sure that the cable is properly connected. If you are using external power, make certain that the YSI 6037 or 6038 power supply or other 12 vdc source is properly working. Recheck the setup of the Com port and other software parameters. Also refer to **Section 6, Troubleshooting**.

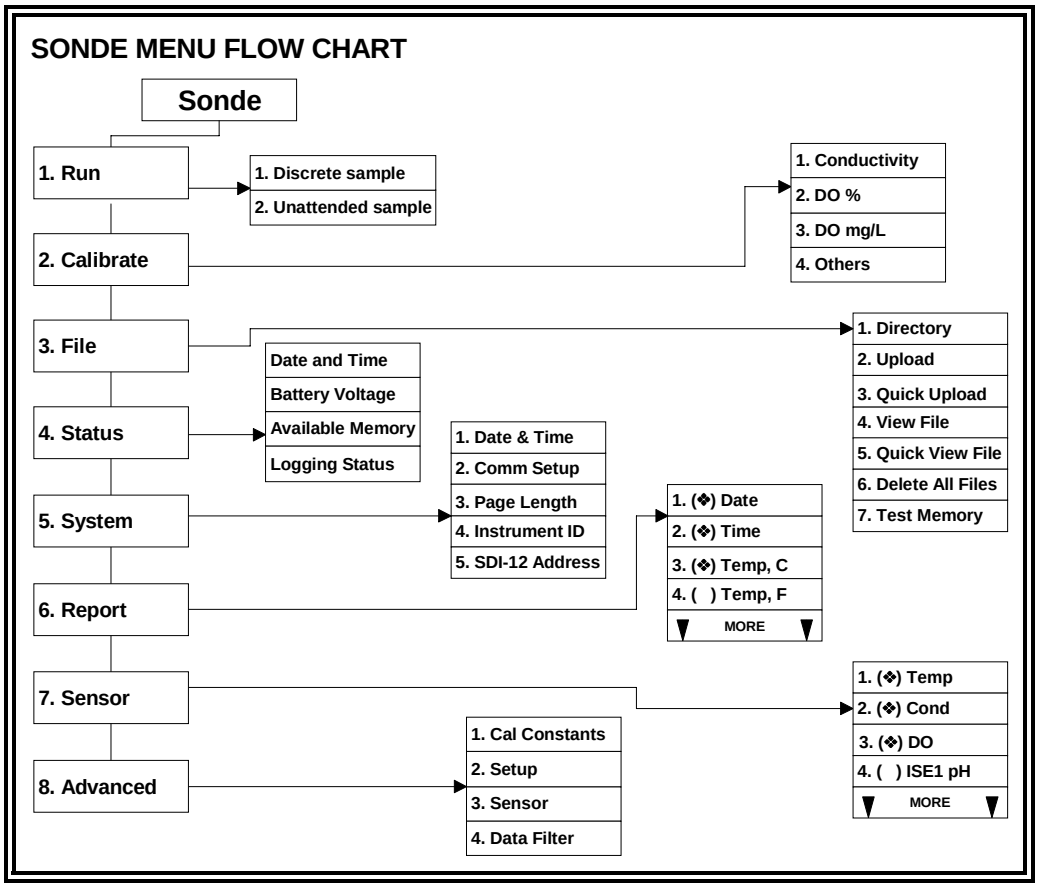
The sonde software is menu-driven. You select functions by typing their corresponding numbers. You do not need to press **Enter** after choosing a selection. Type the **0 or Esc** key to return to the previous menu.

Sonde Main Menu

```
------------------Main-----------------
1-Run                5-System
2-Calibrate          6-Report
3-File               7-Sensor
4-Status             8-Advanced

Select option (0 for previous menu):
```

Figure 31 - Sonde Menu Flow Chart



SYSTEM SETUP

At the Main menu, select **System**. The System Setup menu will be displayed.

System Setup Menu

```
--------------System setup-------------
1-Date & time
2-Comm setup
3-Page length=25
4-Instrument ID=NotSet
5-SDI-12 address=0
6-(*)English
7-( )Français
8-( )Deutsch

Select option (0 for previous menu):
```

Select **Date & time**. An asterisk will appear next to each selection to confirm the entry. Press 4 and 5 to activate the date and time functions. Pay particular attention to the date format that you have chosen when entering date. Use the 24-hour clock format for entering time. Option **4- ( ) 4 digit** year may be used so that the date will appear with either a two or four digit year display. If you do not enter the correct year format (8/30/**98** for 2-digit, 8/30/**1998** for 4 digit) your entry will be rejected.

```
-----------Date & time setup-----------
1-(*)m/d/y          4-( )4 digit year
2-( )d/m/y          5-Date=08/11/98
3-( )y/m/d          6-Time=11:12:30

Select option (0 for previous menu):
```

Press **0** or **Esc** to return the **System Setup** menu.

Select **Comm setup** From the **System Setup** menu.

```
---------------Comm setup-------------
1-(*)Auto baud      5-( )2400 baud
2-( )300 baud       6-( )4800 baud
3-( )600 baud       7-(*)9600 baud
4-( )1200 baud

Select option (0 for previous menu): 0
```

The default is 9600, but you may change it to match your host communication interface protocol by typing in the corresponding number, **1** through **7**. An asterisk confirms the selection. Auto baud may be selected along with any of the choices. The Auto baud option allows the sonde to recognize and adjust to the received characters. It is recommended that the Auto Baud be activated.

NOTE: If you change the baud rate, immediately change the baud rate in EcoWatch. If you do not adjust the baud rate in the PC software, the sonde will not be able to communicate with EcoWatch or any display/logger and your system will appear to be "locked-up." See **Section 2.4**, **EcoWatch for Windows,** for more information.

Press **Esc** or **0** to return to the System Setup menu.

Select **Page length**, from the System Setup menu, to adjust the page length and press **Enter**. This will allow you to control how many lines of data are sent to your display before a new header is shown. The smaller the page number, the fewer the lines of data will be transmitted to your display between headers. However, if you set the page length to zero (0), only the initial header will be displayed. In many cases, a page length of zero is the preferred configuration if you choose to upload your data in an ASCII or CDF format. See **Section 2.9, Sonde Menu** for more details.

Select **Instrument ID** from the System setup menu to record the instrument ID number (usually the instrument serial number), and press **Enter**. A prompt will appear which will allow you to type in the serial number of your sonde. This will make sure that any data that is collected is associated with a particular sonde.

Press **Esc** or **0** to return to the **System setup** menu.

The SDI-12 default address is zero (0). This feature is fully described in **Section 7, Communication** and only utilized if the unit is to operate in a SDI-12 communication protocol network.

At the bottom of the menu choose the language you prefer for the sonde software.

```
--------------System setup-------------
1-Date & time
2-Comm setup
3-Page length=25
4-Instrument ID=NotSet
5-SDI-12 address=0
6-(*)English
7-( )Français
8-( )Deutsch
```

Select option (0 for previous menu).

Then press **Esc** or **0** again to return to the **Main menu**.

ENABLING SENSORS

To activate the sensors that are in your sonde, select **Sensor** from the Sonde Main menu.

```
------------Sensors enabled------------
1-(*)Time
2-(*)Temperature
3-(*)Conductivity
4-(*)Dissolved Oxy
5-(*)ISE1 pH
6-(*)ISE2 Orp
7-(*)ISE3 NH4+
8-(*)ISE4 NO3-
9-( )ISE5 NONE
A-(*)Optic Turbidity

Select option (0 for previous menu):
```

Note that the exact appearance of this menu will vary depending upon the sensors that are available on your sonde. Enter the corresponding number to enable the sensors that are installed on your sonde. An asterisk indicates that the sensor is enabled.

When selecting ISE2, ISE3, ISE4, or ISE5 ports, a submenu will appear. When this occurs, make a selection so that the sensor corresponds to the port in which the sensor is physically installed. Only ORP can be enabled as ISE2. Optic Turbidity and Optic Chlorophyll also appear on a submenu.

After all installed sensors have been enabled, press **Esc or 0** to return to the Main Menu.

In order for a specific parameter to be displayed:

1. The sensor must first be enabled as described above.
2. That parameter must be activated in the Report Setup menu described below.

Select **Report** from the Main menu. A Report Setup menu similar to the one shown below will be displayed.

```
--------------Report setup-------------
1-(*)Date m/d/y     E-(*)Orp mV
2-(*)Time hh:mm:ss  F-(*)NH4+ N mg/L
3-(*)Temp C         G-( )NH4+ N mV
4-(*)SpCond mS/cm   H-( )NH3 N mg/L
5-( )Cond           I-(*)NO3- N mg/L
6-( )Resist         J-( )NO3- N mV
7-( )TDS            K-(*)Cl- mg/L
8-( )Sal ppt        L-( )Cl- mV
9-(*)DOsat %        M-(*)Turbid NTU
A-(*)DO mg/L        N-(*)Chl ug/L
B-( )DOchrg         O-(*)Fluor %FS
C-(*)pH             P-(*)Battery volts
D-( )pH mV

Select option (0 for previous menu):
```

Note that the exact appearance of this menu will vary depending upon the sensors that are available and enabled on your sonde. The asterisks (*) that follow the numbers or letters indicate that the parameter will appear on all outputs and reports. To turn a parameter on or off, type the number or letter that corresponds to the parameter.

For parameters with multiple unit options such as temperature, conductivity, specific conductance, resistivity and TDS, a submenu will appear as shown below, allowing selection of desired units for this parameter.

```
--------------Select units-------------
1-(*)NONE
2-( )Temp C
3-( )Temp F
4-( )Temp K

Select option (0 for previous menu): 2
```

After configuring your display with the desired parameters, press **Esc or 0** to return to the Main menu.

Select **Advanced** from the Main menu. The following menu will be displayed.

```
----------------Advanced-------------
1-Cal constants
2-Setup
3-Sensor
4-Data filter

Select option (0 for previous menu):
```

It is important that the settings in the following three submenus match the displays in your sonde software. Select **Setup** from the Advanced menu.

```
-------------Advanced setup-----------
1-(*)VT100 emulation
2-( )Power up to Menu
3-( )Power up to Run
4-( )Comma radix
5-(*)Auto sleep RS232
6-(*)Auto sleep SDI12
7-( )Multi SDI12
8-( )Full SDI12

Select option (0 for previous menu): 0
```

To enable or disable any selection, press the corresponding number. To change the value of a parameter, press the appropriate number, type the value and press **Enter** to confirm your entry. For more information, see **Section 2.9.8, Advanced**. For the 600R, 600XL and 6820, the Auto sleep RS232 should usually be “off’. For the 600XLM, 6600 and 6920 sondes, the Auto sleep RS232 should usually be “on”. This is described in detail in **Section 2.9, Sonde Menu**. When this setup is verified, press **Esc** or **0** to return to the Advanced menu.

Select number **3-Sensor** from the Advanced menu.

```
------------Advanced sensor-----------
1-TDS constant=0.65
2-Latitude=40
3-Altitude Ft=0
4-(*)Fixed probe
5-( )Moving probe
6-DO temp co %/C=1.1
7-DO warm up sec=40
8-(*)Wait for DO
9-Wipes=1
A-Wipe int=1
B-SDI12-M/wipe=1
C-Turb temp co %/C=0.3
D-(*)Turb spike filter
E-Chl temp co %/C=0
F-(*)Chl spike filter

Select option (0 for previous menu):
```

In particular, number **8-( )Wait for DO** should be disabled. If you have a depth sensor installed, you can maintain the default settings of 40 and 0 for numbers **2-Latitude and 3-Altitude**, respectively, without affecting your ability to learn the basic calibration and operation of the sonde. However, if you know the appropriate values for your location, change them. When this setup is verified, press **Esc** or **0** to return to the Advanced menu. For more information, see **Section 2.9.8, Advanced**.

The display under number **3-Sensor** may be different from the one shown in the example above, depending on the sensors that are installed in your unit. For example, if you do not have a chlorophyll probe, the last two entries (which are relevant only to chlorophyll) will not appear.

In the advanced menu, select number **4-Data filter**. Sondes with **neither turbidity nor chlorophyll probes enabled** will display the following menu.

```
------------Data filter setup----------
1-(*)Enabled
2-( )Wait for filter
3-Time constant=4
4-Threshold=0.001

Select option (0 for previous menu):
```

If either **turbidity or chlorophyll is enabled** then the menu will appear as follows.

```
------------Data filter setup----------
1-(*)Enabled
2-( )Wait for filter
3-Time constant. . .
4-Threshold. . .

Select option (0 for previous menu):
```

Choosing 3 for Time Constant will display something similar to the following:

```
------------Time constant ----------
1- Turbid=12
2- Chl=12
3- Other=4


Select option (0 for previous menu):
```

These are the recommended settings for the time constants. Note that the time constant can be set independently for turbidity and chlorophyll. All other sensors use the same time constant. Setting thresholds is done in the same manner. Recommended threshold settings are 0.01 for turbidity, 1.0 for chlorophyll, and 0.001 for other.

When this setup is verified, press **Esc** or **0** to return to the Advanced menu. For a detailed explanation of the choices in the Advanced menu, see **Section 2.9.8, Advanced**. Press **Esc** or **0** to back up to the Main menu. The sonde software is now set up and ready to calibrate and run.

2.6 GETTING READY TO CALIBRATE

HEALTH AND SAFETY

Reagents that are used to calibrate and check this instrument may be hazardous to your health. Take a moment to review health and safety information in Appendix A of this manual. Some calibration standard solutions may require special handling.

CONTAINERS NEEDED TO CALIBRATE A SONDE

The calibration cup that comes with your sonde serves as a calibration chamber for all calibrations and minimizes the volume of calibrant reagents required. However, if you are using the 6026 "wiping" turbidity probe or the 6025 "wiping" chlorophyll probe, you should visually verify proper movement of the wiper mechanism before beginning the calibration procedures.

Instead of the calibration cup, you may use laboratory glassware to perform calibrations. If you do not use a calibration cup that is designed for the sonde, you are cautioned to do the following:

- ✓ Perform all calibrations with the Probe Guard installed. This protects the probes from possible physical damage.
- ✓ Use a ring stand and clamp to secure the sonde body to prevent the sonde from falling over. Much laboratory glassware has convex bottoms.
- ✓ Insure that all sensors are immersed in calibration solutions. Many of the calibrations factor in readings from other probes (e.g., temperature probe). The top vent hole of the conductivity sensor must also be immersed during calibrations.

CALIBRATION TIPS

1. If you use the Calibration Cup for dissolved oxygen (DO) calibration, make certain to loosen the seal to allow pressure equilibration before calibration. The DO calibration is a water-saturated air calibration.

2. The key to successful calibration is to insure that the sensors are completely submersed when calibration values are entered. Use recommended volumes when performing calibrations.

3. For maximum accuracy, use a small amount of previously used calibration solution to pre-rinse the sonde. You may wish to save old calibration standards for this purpose.

4. Fill a bucket with ambient temperature water to rinse the sonde between calibration solutions.

5. Have several clean, absorbent paper towels or cotton cloths available to dry the sonde between rinses and calibration solutions. Shake the

excess rinse water off of the sonde, especially when the probe guard is installed. Dry off the outside of the sonde and probe guard. Making sure that the sonde is dry reduces carry-over contamination of calibrator solutions and increases the accuracy of the calibration.

6. If you are using laboratory glassware for calibration, you do not need to remove the probe guard to rinse and dry the probes between calibration solutions. The inaccuracy resulting from simply rinsing the probe compartment and drying the outside of the sonde is minimal.

7. If you are using laboratory glassware for the 600R, 600XL and 600XLM, remove the stainless steel weight from the bottom of the sonde by turning the weight counterclockwise. When the weight is removed, the calibration solutions have access to the sensors without displacing a lot of fluid. This also reduces the amount of liquid that is carried between calibrations.

8. Make certain that port plugs are installed in all ports where probes are not installed. It is extremely important to keep these electrical connectors dry.

RECOMMENDED VOLUMES FOR USE WITH THE CALIBRATION CUP

Follow these instructions to use the calibration cup for calibration procedures with all of the instruments except the 600R. For the 600R, the over-the-guard bottle that comes with your sonde, must be used.

- ✓ Ensure that a gasket is installed in the gasket groove of the calibration cup bottom cap, and that the bottom cap is securely tightened. **Note:** Do not over-tighten as this could cause damage to the threaded portions of the bottom cap and tube.

- ✓ Remove the probe guard, if it is installed.

- ✓ Remove the o-ring, if installed, from the sonde.

- ✓ Inspect the installed gasket on the sonde for obvious defects and if necessary, replace it with the extra gasket, supplied.

- ✓ Screw cup assembly into place on the threaded end of sonde and securely tighten. N**ote:** Do not over tighten as this could cause damage to the threaded portions of the bottom cap and tube.

- ✓ Sonde calibration can be accomplished with the sonde upright or upside down. A separate clamp and stand, such as a ring stand, is required to support the sonde in the inverted position.

- ✓ To calibrate, follow the procedures in the next section, Calibration Procedures. The approximate volumes of the reagents are specified below for both the upright and upside down orientations.

- ✓ When using the Calibration Cup for dissolved oxygen calibration, make certain that the vessel is vented to the atmosphere by loosening the bottom cap or cup assembly, depending on orientation, and that approximately 1/8" of water is present in the cup.

Table 1 6820 and 6920 Sondes

Probe to Calibrate	**Upright**	**Upside Down**
Conductivity	200ml	200ml
pH/ORP	100ml	250ml
ISE	125ml	275ml
Turbidity or Chlorophyll	25ml	N/A

Table 2 600XL and 600XLM Sondes

Probe to Calibrate	**Upright**	**Upside Down**
Conductivity	50ml	50ml
pH/ORP	25ml	50ml

Table 3 6600 Sonde

Probe to Calibrate	**Upright**	**Upside Down**
Conductivity	425ml	225ml
pH/ORP	300ml	275ml
ISE	300ml	275ml
Turbidity or Chlorophyll	130ml	N/A

2.6.1 CALIBRATION PROCEDURES

The following calibration procedures are for the most commonly used sensors. For detailed information on all calibration procedures, refer to **Section 2.9.2, Calibrate**.

To ensure more accurate results, you can rinse the calibration cup with water, and then rinse with a small amount of the calibration solution for the sensor that you are going to calibrate. Discard the rinse solution and add fresh calibrator solution. Use tables 1, 2 and 3 to find the correct amount of calibrator solution.

1. Carefully immerse the probes into the solution and rotate the calibration cup to engage several threads. YSI recommends supporting the sonde with a ring stand and clamp to prevent the sonde from falling over.

2. With a field cable connecting the sonde to a PC, access EcoWatch for Windows and proceed to the Main menu (for information on how to run EcoWatch for Windows software, see **Section 2.4.2, Running EcoWatch Software)**. From the sonde Main menu, select number **2-Calibrate**.

3. Note that the exact appearance of this menu will vary depending upon the sensors that are available and enabled on your sonde. To select any of the parameters from the Calibrate menu, input the number that is next to the parameter and press **Enter**. Once you have chosen a parameter, some of the parameters will have a number that appears in parentheses. These are the default values and will be used during calibration if you press **Enter** without inputting another value. If no default value appears, you must type a numerical value and press **Enter**.

```
---------------Calibrate-------------
1-Conductivity      5-ISE2 ORP
2-Dissolved Oxy     6-ISE3 NH4+
3-Pressure-Abs      7-ISE4 NO3-
4-ISE1 pH           8-Turbidity

Select option (0 for previous menu):
```

4. After you input the calibration value, or accept the default, press **Enter**. A real-time display will appear on the screen. Carefully observe the stabilization of the readings of the parameter that is being calibrated. When the readings have been stable for approximately 30 seconds, press **Enter** to accept the calibration. The calibrated value is bolded on the example screen on the following page.

5. Press **Enter** to return to the Calibrate menu, and proceed to the next calibration.

NOTE: If an ERROR message appears, begin the calibration procedure again. Be certain that the value you enter for the calibration standard is correct. Also see **Section 6, Troubleshooting** for more information on error messages. If you continue to observe error messages during calibration, contact YSI Customer Service. See **Section 8, Warranty and Service Information**.

```
=================================================================
 Temp SpCond    Sal DOsat     DO   Depth    pH NH4+ N NO3- N Turbid
    C  mS/cm    ppt     %   mg/L    feet         mg/L   mg/L    NTU
-----------------------------------------------------------------
To calibrate, press <Enter> when the readings are stable.
23.52  7.496   4.13  98.4   8.36   0.310  7.15  11.03  0.000    0.9
```

You will find specific start-up calibration procedures for all sensors that commonly require calibration in the following sections. If a sensor listed is not installed in your sonde, skip that section and proceed to the next sensor until the calibration protocol is complete. Before you use the sonde in the laboratory or field, read and study the more-detailed information on calibration in **Section 2.9.2, Calibrate**.

Temperature does not require calibration, and is therefore not included in the Calibrate menu. ORP calibration is required only infrequently and is only discussed in **Section 2.9.2, Calibrate.**

CONDUCTIVITY

This procedure calibrates conductivity, specific conductance, salinity, and total dissolved solids.

Place approximately the correct amount (by using tables 1, 2 and 3) of conductivity standard into a clean, dry or pre-rinsed calibration cup.

For maximum accuracy, the conductivity standard you choose should be within the same conductivity range as the water you are preparing to sample. However, we do not recommend using standards less than 1 mS/cm. For example:

- ✓ For fresh water use a 1 mS/cm conductivity standard.
- ✓ For brackish water use a 10 mS/cm conductivity standard.
- ✓ For seawater use a 50 mS/cm conductivity standard.

Before proceeding insure that the sensor is as dry as possible. Ideally, rinse the conductivity sensor with a small amount of standard that can be discarded. Be certain that you avoid cross-contamination of standard solutions with other solutions. Make certain that there are no salt deposits around the oxygen and pH/ORP probes, particularly if you are employing standards of low conductivity.

Carefully immerse the probe end of the sonde into the solution. Gently rotate and/or move the sonde up and down to remove any bubbles from the conductivity cell. The probe must be completely immersed past its vent hole. Using the recommended volumes from the table in the previous subsection should insure that the vent hole is covered.

Allow at least one minute for temperature equilibration before proceeding.

From the Calibrate menu, select number **1-Conductivity** to access the Conductivity calibration procedure and then number **1-SpCond** to access the specific conductance calibration procedure. Enter the calibration value of the standard you are using (mS/cm at 25°C) and press **Enter**. The current values of all enabled sensors will appear on the screen and will change with time as they stabilize.

Observe the readings under Specific Conductance or Conductivity and when they show no significant change for approximately 30 seconds, press **Enter**. The screen will indicate that the calibration has been accepted and prompt you to press **Enter** again to return to the Calibrate menu.

Rinse the sonde in tap or purified water and dry the sonde.

DISSOLVED OXYGEN

Place approximately 3 mm (1/8 inch) of water in the bottom of the calibration cup. Place the probe end of the sonde into the cup. Make certain that the DO and temperature probes are <u>not</u> immersed in the water. Engage only 1 or 2 threads of the calibration cup to insure the DO probe

is vented to the atmosphere. Wait approximately 10 minutes for the air in the calibration cup to become water saturated and for the temperature to equilibrate.

Two calibration protocols are provided below for dissolved oxygen, one for sampling applications and one for long-term monitoring applications.

Sampling Applications

If your instrument will be used in sampling applications where the dissolved oxygen is pulsing continuously, deactivate "Autosleep RS232" as described in **Section 2.5, Sonde Software Setup**.

From the Calibrate menu, select number **2-Dissolved Oxy**, then number **1-DO %** to access the DO percent calibration procedure. Calibration of dissolved oxygen in the DO % procedure also results in calibration of the DO mg/L mode and vice versa.

Enter the current barometric pressure in mm of Hg. (Inches of Hg x 25.4 = mm Hg).
Caution: Barometer readings that appear in meteorological reports are generally corrected to sea level and are not useful for your calibration procedure unless they are uncorrected.

Press **Enter** and the current values of all enabled sensors will appear on the screen and change with time as they stabilize. Observe the readings under DO %. When they show no significant change for approximately 30 seconds, press **Enter**. The screen will indicate that the calibration has been accepted and prompt you to press **Enter** again to return to the Calibrate menu.

Rinse the sonde in water and dry the sonde.

Monitoring Applications

If your instrument will be used in monitoring applications where data is being captured at a longer interval (e.g. 15 – 60 minutes) to internal sonde memory, a data collection platform or a computer, you need to activate "Autosleep RS232" as described in **Section 2.5, Sonde Software Setup**. Then follow the instructions detailed above for the Sampling Application calibration. With Autosleep active, the calibration will occur automatically with a display similar to that shown below.

```
=================================================================
 Temp SpCond    Sal DOsat     DO   Depth    pH NH4+ N NO3- N Turbid
    C  mS/cm    ppt     %   mg/L    feet         mg/L   mg/L    NTU
-----------------------------------------------------------------
Stabilizing: 38
```

After the warm-up time is complete, the readings just before and just after calibration are displayed. When you press **Enter**, the screen returns to the DO Calibration menu.

DEPTH AND LEVEL

For the depth and level calibration, you can leave the sonde set up the same way as for dissolved oxygen, in water-saturated air.

From the Calibrate menu, select number **3-Pressure-Abs** (or number **3-Pressure-Gage** if you have a vented level sensor) to access the depth calibration procedure. Input 0.00 or some known sensor offset in feet. Press **Enter** and monitor the stabilization of the depth readings with time. When no significant change occurs for approximately 30 seconds, press **Enter** to confirm the calibration. This zeros the sensor with regard to current barometric pressure. Then press **Enter** again to return to the Calibrate menu.

For best performance of depth measurements, users should ensure that the sonde's orientation remains constant while taking readings. This is especially important for vented level measurements and for sondes with side mounted pressure sensors.

pH 2-POINT

Using the correct amount of pH 7 buffer standard (from tables 1, 2 and 3) in a clean, dry or pre-rinsed calibration cup, carefully immerse the probe end of the sonde into the solution. Allow at least 1 minute for temperature equilibration before proceeding.

From the Calibrate menu, select number **4-ISE1 pH** to access the pH calibration choices and then press number **2- 2-Point**. Press **Enter** and input the value of the buffer (7 in this case) at the prompt. Press **Enter** and the current values of all enabled sensors will appear on the screen and change with time as they stabilize in the solution. Observe the readings under pH and when they show no significant change for approximately 30 seconds, press **Enter**. The display will indicate that the calibration is accepted.

After the pH 7 calibration is complete, press **Enter** again, as instructed on the screen, to continue. Rinse the sonde in water and dry the sonde before proceeding to the next step.

Using the correct amount (from tables 1, 2 and 3) of an additional pH buffer standard into a clean, dry or pre-rinsed calibration cup, carefully immerse the probe end of the sonde into the solution. Allow at least 1 minute for temperature equilibration before proceeding.

Press **Enter** and input the value of the second buffer at the prompt. Press **Enter** and the current values of all enabled sensors will appear on the screen and will change with time as they stabilize in the solution. Observe the readings under pH and when they show no significant change for approximately 30 seconds, press **Enter**. After the second calibration point is complete, press **Enter** again, as instructed on the screen, to return to the Calibrate menu.

Rinse the sonde in water and dry. Thoroughly rinse and dry the calibration containers for future use.

The next calibration instructions are only for the 6820, 6600 and 6920 sondes. If you do not have one of these sondes, you may skip to 2.7, Taking Readings.

AMMONIUM (NH_4^+) , CHLORIDE Cl^- AND NITRATE (NO_3^-) 3-POINT

WARNING: AMMONIUM AND NITRATE SENSORS CAN ONLY BE USED AT DEPTHS OF LESS THAN 50 FEET (15 METERS). USE OF THE SENSORS AT GREATER DEPTHS IS LIKELY TO PERMANENTLY DAMAGE THE SENSOR MEMBRANE.

The calibration procedures for ammonium, nitrate or chloride are similar to pH except for the reagents in the calibration solutions. Suggested values for calibrants are 1 and 100 mg/L of either ammonium-nitrogen (NH_4-N) or nitrate-nitrogen (NO_3-N). Suggested values for calibrants are 10 and 1000 mg/L of Chloride (Cl^-).

NOTE: The following procedure requires one portion of the high concentration calibrant and two portions of the low concentration calibrant. The high concentration solution and one of the low concentration solutions should be at ambient temperature. The other low concentration solution should be chilled to less than 10°C prior to beginning the procedure.

Place the proper amount of 100 mg/L standard (1000mg/l for chloride) into a clean, dry or pre-rinsed transport cup. Carefully immerse the probe end of the sonde into the solution. Allow at least 1 minute for temperature equilibration before proceeding.

Select number **6-Ammonium, 7-Nitrate** or number **8- Chloride** to access the appropriate calibration choices. Then select number **3-3-Point**. Press **Enter** and input the concentration value of the standard as requested. Press **Enter** and the current values of all enabled sensors will appear on the screen and will change with time as they stabilize in the solution. Observe the readings under $NH4^+$, $NO3^-$, or Cl^-. When they show no significant change for approximately 30 seconds, press **Enter**.

After the first calibration point is complete, proceed as instructed on the screen, to continue. Rinse the sonde in water and dry the sonde prior to the next step.

Place the proper amount of 1 mg/L standard for Ammonium or Nitrate (10 mg/l for Chloride) into a clean, dry or pre-rinsed transport cup. Carefully immerse the probe end of the sonde into the solution. Allow at least 1 minute for temperature equilibration before proceeding.

Press **Enter** and input the concentration value of the standard as requested.

Press **Enter** and the current values of all enabled sensors will appear on the screen and will change with time as they stabilize in the solution. Observe the readings under $NH4^+$, $NO3^-$, or Cl^- .and when they have show no significant change for approximately 30 seconds, press **Enter**.

After the second value calibration is complete, press **Enter** to continue. Place the proper amount of chilled 1 mg/L standard (10 mg/L for the chloride) into a clean, dry or pre-rinsed calibration cup. Carefully immerse the probe end of the sonde into the solution. Allow at least 5 minutes for temperature equilibration before proceeding.

Press **Enter** and input the concentration value of the standard as requested.
Press **Enter** and the current values of all enabled sensors will appear on the screen and will change with time as they stabilize in the solution. Observe the readings under $NH4^{+}$, $NO3^{-}$ or Cl^{-} and when they show no significant change for approximately 30 seconds, press **Enter**.
After the third value calibration is complete, press **Enter** to return to the Calibrate menu.

Thoroughly rinse and dry the calibration cups for future use.

CALIBRATION TIP: HOW TO AVOID DRIFT DURING CALIBRATION OF THE NH4+, NO3- AND Cl- PROBES AFTER pH CALIBRATION. Exposure to the high ionic content of pH buffers can cause a significant, but temporary, drift in these ISE probes (ammonium, nitrate and chloride probes). Therefore, when calibrating the pH probe, YSI recommends that you use one of the following methods to minimize errors in the subsequent readings:

- Calibrate pH first, immersing all of the probes in the pH buffers. After calibrating pH, place the probes in 100 mg/L nitrate or ammonium standard (1000 mg/L chloride) and monitor the reading. Usually, the reading starts low and may take as long as 30 minutes to reach a stable value. When it does, proceed with the calibration.

- When calibrating pH, remove the probe guard and immerse only the pH and temperature probes in the buffers. You can then calibrate nitrate, ammonium or chloride immediately. This will be virtually impossible if a turbidity probe is installed.

TURBIDITY 2-POINT

Select **8-Turbidity** from the Calibrate Menu and then **2-2-Point**.

NOTE: One standard must be 0 NTU, and this standard must be calibrated first.

To begin the calibration, the correct amount (from tables 1, 2 and 3) of 0 NTU standard (clear deionized, distilled, or tap water) into the clear calibration cup (provided) or in a glass beaker. With the probe guard installed, immerse the sonde in the water**.** Input the value 0.00 NTU at the prompt, and press **Enter**. The screen will display real-time readings that will allow you to determine when the readings have stabilized. If you have a mechanically-cleaned turbidity probe installed, activate the wiper 1-2 times by pressing number **3-Clean Optics** as shown on the screen to remove any bubbles. If your probe is not mechanically cleaned, rotate the sonde back and forth in the water to facilitate removal of bubbles. After stabilization is complete, press **Enter** to "confirm" the first calibration and then, as instructed, press **Enter** to continue.

Dry the sonde carefully and then place the sonde in the second turbidity standard (100 NTU is suggested) using the same container as for the 0 NTU standard. Input the correct turbidity value in NTU, press **Enter**, and view the stabilization of the values on the screen in real-time. As above, activate the wiper with the "3" key or manually rotate the sonde to remove bubbles. After the readings have stabilized, press **Enter** to confirm the calibration and then press **Enter** to return to the Calibrate menu.

Thoroughly rinse and dry the calibration cups for future use. For additional information related to calibrating the turbidity sensor, see **Appendix E, Turbidity Measurements**.

CHLOROPHYLL 1-POINT

Select **Optic Chlorophyll** from the Calibrate Menu and then select **Chl µg/L**. Then select **1-1 point.**

NOTE: This procedure will zero your fluorescence sensor and use the default sensitivity for calculation of chlorophyll concentration in µg/L**.** The default sensitivity is usually within 25 % for any probe. The 1-point calibration will therefore allow quick and easy fluorescence measurements that are only semi-quantitative with regard to chlorophyll. However, the readings will reflect changes in chlorophyll from site to site, or over time at a single site.

To increase the accuracy of your chlorophyll measurements, follow the 2-point or 3-point calibration protocols outlined in **Section 2.9, Sonde Menu**.

Before making any field readings, carefully read Sections 5.12, **Chlorophyll a**nd **Appendix I, Chlorophyll** about chlorophyll that describe practical aspects of fluorescence measurements.

To begin the calibration, place the correct amount of clear deionized or distilled water, from Tables 1, 2 and 3, into the YSI clear calibration cup provided or in a glass beaker of an appropriate size (600 mL for 6820 and 6920 sondes; 800 mL for the 6600 sonde). With the probe guard installed, immerse the sonde in the water**.** Input the value 0 µg/L at the prompt, and press **Enter**. The screen will display real-time readings that will allow you to determine when the readings have stabilized. Activate the wiper 1-2 times by pressing number **3-Clean Optics** as shown on the screen to remove any bubbles from the sensor. After stabilization is complete, press **Enter** to "confirm" the calibration and then, as instructed, press **Enter** to return to the Calibrate menu.

Thoroughly rinse and dry the calibration cups for future use. For additional information related to calibrating the chlorophyll sensor, see Sections 5.12, **Chlorophyll** and **Appendix I, Chlorophyll**.

2.7 TAKING READINGS

After you have (1) enabled the sensors, (2) set the report to show the parameters that you want to see, and (3) calibrated the sensors, you are now ready to take readings.

There are two basic approaches to sampling, discrete and unattended. Using discrete sampling, the sonde is connected via a communication cable to a PC or terminal. The sampling frequency is likely to be rapid (seconds) in order to obtain a representative sampling as you move from site to site. Readings will probably be logged to several different files.

Unattended sampling is normally done with sondes that have internal batteries. The sampling frequency is likely to be longer (minutes). A sonde is typically deployed for days or weeks at a time, and readings will log to a single file. The communication cable may be disconnected and internal battery power used to operate the sonde. Alternatively, the sonde may connect via SDI-12 communication to a data collection platform (DCP). Sondes without batteries need to be connected to an external power source to sample unattended.

Select number **1-Run** from the Main menu to begin taking readings or to set/verify the parameters required for a study. There are two options in the Run menu as shown below.

```
---------------Run setup---------------
1-Discrete sample   2-Unattended sample

Select option (0 for previous menu): 1
```

DISCRETE SAMPLING

Select number **1-Discrete sample** from the Run menu. The Discrete sample menu will be displayed.

```
------------Discrete sample------------
1-Start sampling
2-Sample interval=4
3-File=
4-Site=
5-Open file

Select option (0 for previous menu):
```

Select number **2 - Sample Interval** to type a number that represents the number of seconds between samples. The maximum sample interval is 32767 seconds (9+ hours). The factory default sample interval is 4 seconds and works best for most discrete sampling applications. See section 2.9.1 for more details.

Select number **3 -File** to enter a filename with a maximum of 8 characters. This is the file to which you will log readings.

If you started sampling without entering a filename, the default name NONAME1 will be assigned to your file. Whenever you press 1-LOG last sample or 2-LOG ON/OFF from the menu, NONAME1 will be opened during sampling. If this happens, and you want to restart the file with a different name, press **5-Close file** and rename the file.

Select number **4-Site** to assign a site name with a maximum of 31 characters This allows you to enter the name of the site where you are sampling.

When you select number **5-Open File**, a file is opened and the number 5 changes to **Close File**. When you are finished logging data to the file, press **5-Close File** and number 5 changes back to **Open File**.

Now select number **1-Start sampling** to start discrete sampling.

After the initial sampling time interval has passed, (e.g. 4 seconds in the example above), sequential lines of data will appear on the screen.

```
=============================================================
 Temp    Sal DOsat     DO   Depth    pH NH4+ N NO3- N Turbid
    C    ppt     %   mg/L    feet         mg/L   mg/L    NTU
-------------------------------------------------------------
*** 1-LOG last sample   2-LOG ON/OFF, 3-Clean optics ***
23.54   0.00  96.5   8.20   1.001  5.20  0.853  0.522    0.3
*** LOG is ON,  hit 2 to turn it OFF, 3-Clean optics ***
23.53   0.00  96.5   8.20   1.001  5.20  0.856  0.520    0.3
23.53   0.00  96.5   8.20   1.000  5.20  0.854  0.521    0.3
23.53   0.00  96.5   8.20   1.000  5.19  0.852  0.522    0.3
*** 1-LOG last sample   2-LOG ON/OFF, 3-Clean optics ***
23.53   0.00  96.5   8.20   1.000  5.19  0.852  0.522    0.3
Sample logged.
```

The following prompt will appear just below the screen header:
1-LOG last sample, 2-LOG ON/OFF, 3-Clean optics.

By entering **1–LOG last sample**, a single line of data can be logged to flash disk (sonde) memory and the following message will be displayed: **Sample logged.**

By entering **2-LOG ON/OFF**, a set of data can be logged to memory and the following message will be displayed: **LOG is ON, hit 2 to turn it OFF, 3-Clean optics.** Press **2** again to terminate logging.

By entering **3-Clean optics**, if your unit has an optical (chlorophyll or turbidity) probe (with wiper) installed and enabled, the wiper will clean the optical surface**.** The **3-Clean optics** portion of the prompt will only appear if an optical probe was installed and enabled.

Select **Esc** or press **0** to exit discrete sampling.

UNATTENDED SAMPLING

Select number **2-Unattended Sampling** from the Run menu. The Unattended sample menu will be displayed. Use the following example to understand the unattended sampling option.

> **Example:**
> You are going to deploy the sonde for 2 weeks, collecting a set of readings every 15 minutes. You start at 6:00 PM on July 17, 1996 and end the sampling at 6:00 PM on July 31, 1996. The site is Clear Lake, near the spillway, and you want to log all of the readings to a single file CLRLAKE3.

```
------------Unattended setup-----------
1-Interval=00:15:00
2-Start date=07/17/96
3-Start time=18:00:00
4-Duration days=365
5-File=
6-Site=
7-Bat volts: 11.6
8-Bat life 25.1 days
9-Free mem 41.3 days
A-1st sample in 8.10 minutes
B-View params to log
C-Start logging
```

Follow the prompts on this screen to prepare your 600XLM, 6600 or 6920 sonde for unattended deployment as described below:

To verify and/or correct the time and date enter number **4-Status** or number **5-System menu** from the Main menu. You may enter the correct date and time from either of these submenus.

- Select number **1-Interval** and enter the desired time between samples (e.g. 15 minutes in the screen above). Use the 24-hour clock format to enter interval.

- Select number **2-Start Date** and number **3-Start Time** to set the time that data will begin to log to sonde memory. If you do not make any change to these entries, then the study will automatically begin at the next integral time interval, once you have pressed **C-Start logging**.

Example: If the current time is 17:20:00 and your sample interval is 15 minutes, logging will automatically begin at 17:30:00.

It is better to start the study prior to taking the unit to the field so that you can confirm that readings are being saved to memory. If you should desire to start the instrument at the site at 6:00 PM as noted in the above example, change the Start Time to 18:00:00.

- Select number **4-Duration** and set the length of the study in days. The default value is 365 days (which is longer than most deployments). In most cases, you will either want to stop the unattended study manually or allow the batteries to be expended. It is wise to set the duration to a value longer than the anticipated deployment. If you cannot retrieve the sonde at the expected time due to factors beyond your control such as weather or illness, data will continue to be acquired as long as battery power is present.

- Select **5-File** and enter a name of no more than 8 characters that will be used by your external computer to identify the study.

- Select **6-Site** and enter a site name of no more than 31 characters. This filename will appear in your sonde file directory, but will not be used to identify the file after transfer to your computer.

- Check **7-Battery** to make certain that the voltage is suitable for the length of the study that you are about to begin. No change can be made to this item via the software.

- Skip **B-View params to log** in this initial test study. This feature will be explained in detail in **Section 2.9, Sonde Menu**.

After making the above entries, the sonde software will automatically calculate the expected battery life, and the time it will take for the sonde memory to be filled. This information is displayed on the screen for your consideration as items 8, 9, and A. If the battery life or the free memory capacity will be exceeded sooner than the duration, you may want to make some changes to the entries. For example, you can free up memory in the sonde by uploading all existing data from the sonde memory to your PC and then deleting them out of the sonde (see 3-File from Main Menu). You may want to change the batteries for longer battery life. You can lengthen the sampling interval to extend both battery life and memory capacity.

Review the screen below, which now displays the entries made above and reflects your logging conditions.

```
------------Unattended setup----------
1-Interval=00:15:00
2-Start date=07/17/96
3-Start time=18:00:00
4-Duration days=365
5-File=clrlake3
6-Site=Clear Lake at Spillway
7-Bat volts: 11.6
8-Bat life 25.1 days
9-Free mem 41.3 days
A-1st sample in 4.10 minutes
B-View params to log
C-Start logging
```

Once you press **C-Start logging**, a screen will appear to request confirmation.

```
-------------Start logging-------------
Are you sure?
1-Yes
2-No

Select option (0 for previous menu):
```

Select **1-Yes** and the screen will change.

```
----------------Logging---------------
1-Interval=00:15:00
2-Next at 07/17/96
3-Next at 18:00:00
4-Stop at 07/31/96
5-Stop at 18:00:00
6-File=clrlake3
7-Site=Clear Lake at Spillway
8-Bat volts: 11.7
9-Bat life 25.5 days
A-Free mem 41.3 days
B-Stop logging

Select option (0 for previous menu):
```

The display now shows the next date and time for logging, and the stop date and time for the logging study. Most importantly, note that the bottom command now shows **B-Stop logging**, a confirmation that the logging has indeed been initiated.

The Unattended study will terminate when the duration you specified has expired or the batteries are expended. If you want to terminate sooner, simply select **2-Unattended** sample from the Run menu, then **B-Stop logging**. Select **1-yes** and return to the Unattended setup menu.

```
Stop logging?
1-Yes
2-No

Select option (0 for previous menu):
```

2.8 USING ECOWATCH TO CAPTURE, UPLOAD AND ANALYZE DATA

CAPTURE

EcoWatch for Windows can be used to capture data in real-time to your PC's hard drive or to a floppy disk. To utilize this function, interface the sonde to your PC via a COM port, run EcoWatch for Windows, and follow the step by step instructions below.

1. Click on the sonde icon  , choose the proper Com port, and confirm.

2. From the **Main** sonde menu press number **1-Run** and then **1-Discrete Sample**.

3. Make sure that the sample interval is set to the correct value. If it is not, change it to the correct value.

4. Close the terminal window by clicking on the **X** in the upper right hand corner. Do not close EcoWatch for Windows.

5. Open the **Real-Time** menu, click on **New** and select the location where you want to data transferred. Name the file, making sure that the name has extension **.RT**. The default location for the file is in the Data subdirectory of the ECOWWIN directory.

6. Click **OK**. After EcoWatch sets up the sonde for the study, data transfer will begin at the sample rate you selected. The data will be automatically be plotted with autoscaling and saved as a .DAT file at your chosen selection.

7. To terminate the study, open the **Real-Time** men, choose **Close**, and click **OK**.

UPLOAD DATA

EcoWatch for Windows software is reporting and plotting software for use with the YSI 6-Series sondes. Instructions for installing this software were included in **Section 2.1, Getting Started**. This program can also be used to upload and view data logged to flash disk memory in the sonde during either discrete or unattended sampling.

If the sonde was deployed unattended (without a cable), clear debris and water from the bulkhead connector cap. Then remove the cap and connect the calibration cable (or field cable and adapter) from the sonde to your computer.

You may now retrieve data files using the following procedure. Remember these are files in the sonde directory, not files in the EcoWatch directory.

Run EcoWatch software on your PC and select the **Sonde** icon  from the menu bar. Next enter the **File** menu. To upload the most recently recorded logged data, press **3 – Quick Upload**. The sonde will ask you to choose a format for the file. Be sure to choose PC6000 format. The data will be in a .DAT file on your PC.

Select number **1-Directory** to view all files currently stored in the sondes flash disk memory, the screen below shows 5 files. File 4-CLRLAKE2 is a 2-week study from August that can be uploaded to PC6000 for viewing or plotting. The other 4 files are related to different studies. You do not need to upload all files in the directory.

```
  File     Samples  First sample       Last sample        Interval  Site
1-BRIDGE1       20  07/10/96 09:42:52  07/10/96 09:44:12  Discrete  Kenton Rd.
2-BRIDGE2       20  07/10/96 10:15:20  07/10/96 10:16:40  Discrete  Lakeview Dr.
3-UPLAKE       672  07/10/96 12:00:00  07/14/96 12:00:00  00:15:00  Lake Site A
4-CLRLAKE2    1672  08/14/96 11:00:00  08/28/96 11:00:00  00:10:00  Clear Lake
5-DWNLAKE2      21  08/31/96 12:42:31  08/31/96 12:43:54  Discrete  Lake Site B2

Select option (0 for previous menu):
```

Select number **2-Upload** to view file lists in memory, and upload the data to PC-based software.

Prior to upload, a "**Time window**" display appears that will allow you to select portions of the logged data to upload. You may select **1-Proceed** to upload all logged data from the dates and times displayed.

```
--------------Time window--------------
1-Proceed
2-Start date=08/14/96
3-Start time=18:00:00
4-Stop  date=08/28/96
5-Stop  time=11:00:00

Select option (0 for previous menu):
```

Select **1-Proceed**. Choose the appropriate file transfer protocol (in this example, PC6000) and a status box will appear in the lower right quadrant of the screen. Verification of a successful transfer is indicated when all of the requested data are transferred.

```
---------------File type---------------
1-PC6000
2-Comma & ' ' Delimited
3-ASCII Text

Select option (0 for previous menu):
```

Select **4-View File** to examine the data in any file currently stored in the sondes flash disk memory. You will first view the same screen as viewed in the Directory menu. From this menu choose the file of interest, then, using the Time window menu, choose the dates and/or times of interest. If you choose dates or times that are not within the designated start and stop times, no data will be displayed.

You also may choose the entire file. You can use the **Space Bar** to stop and restart the scrolling at any time. Use the **Esc** key to stop the view.

Select number **5-Quick view file** to view the last page of data from the last data file in flash disk memory. This feature is particularly useful to quickly review any recently acquired data so that system performance can be assessed.

Select number **6-Delete** all files to ***IRREVERSIBLY*** remove all files from the sonde flash disk memory. It is critical not to use this option until all relevant data from sonde memory is transferred to your computer via one of the upload options. There is a verification screen that appears, so that pressing the number 6-key does not immediately delete all files.

Select number **7-Test memory** to verify that the flash disk memory system is working properly. During the process, all files will be deleted, so some judgment about the importance of each file is important. Even though all data files will be deleted, there is no effect on setup or calibration information.

REPORTING AND PLOTTING DATA WITH ECOWATCH

There are many features in EcoWatch related to viewing, plotting, manipulating and reporting data collected from a 6-Series sonde. EcoWatch includes a Windows Help section for convenient reference that describes all of the software's features. This section of the manual describes the most commonly used functions of the program and Section 4, **EcoWatch for Windows**, is a detailed manual for EcoWatch software.

For the purposes of describing and demonstrating EcoWatch plotting, reporting and data manipulation capabilities, we use the file SAMPLE.DAT available on the diskette that was enclosed with your 6-series sonde. This file will be copied to your hard drive during EcoWatch installation and should be available to you for the instructions below.

When you are ready to move beyond the example SAMPLE.DAT file and analyze data collected from the sonde, locate and open the appropriate .DAT file from your data upload exercise. These data are located in files that are automatically assigned by EcoWatch and normally would be found at C:\ECOWWIN\DATA\. An example filename is 1097CM01.DAT.

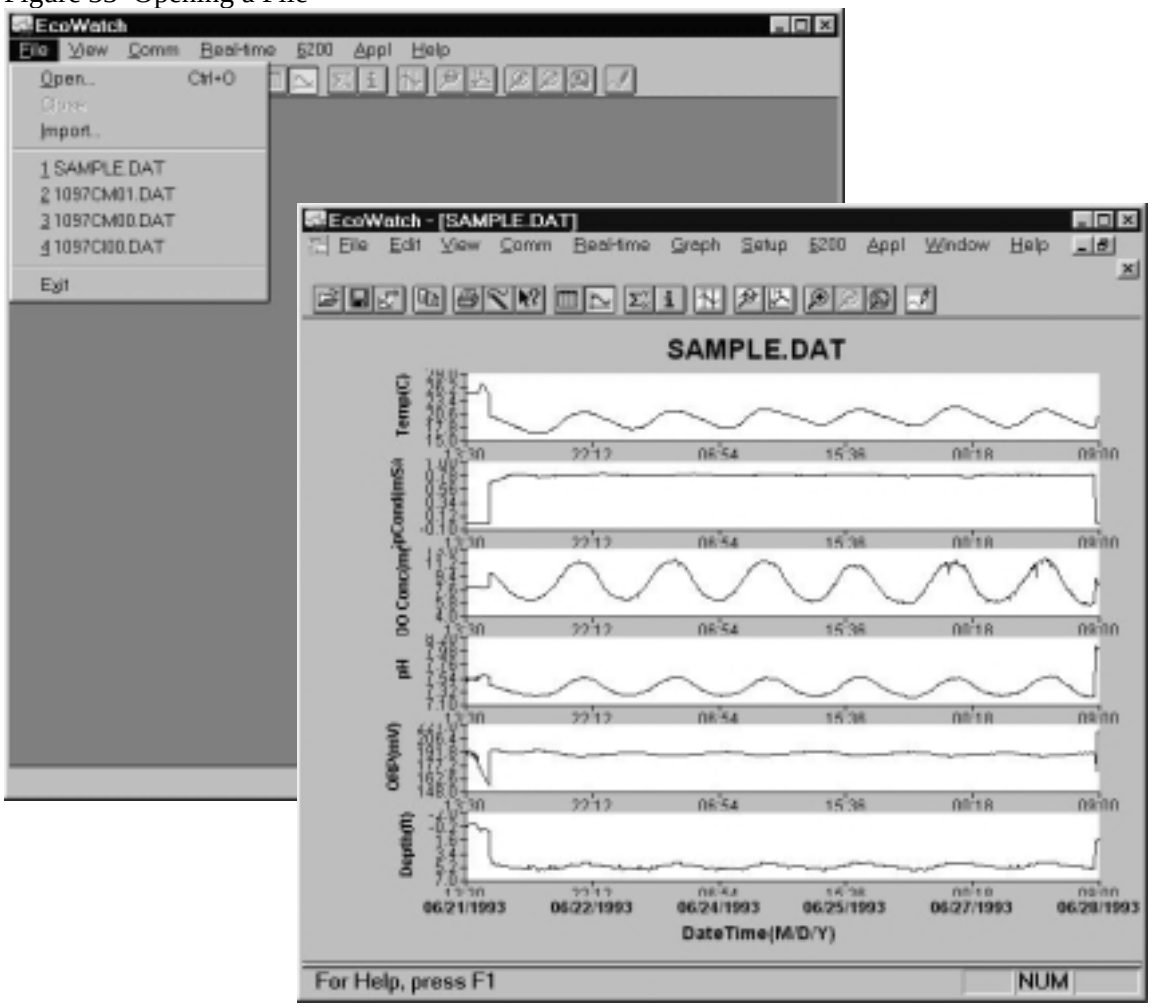
NOTE: In the instructions below that refer to clicking the mouse button, we always refer to the left mouse button unless otherwise specified.

OPENING A DATA FILE

If EcoWatch is not running, open the program by double clicking on the EcoWatch icon. Click on **File** to view a drop-down menu similar to the one shown in figure 33. From this menu click on **Open**, then locate the drive and directory where SAMPLE.DAT (or your file of interest) resides. Alternatively, if you have been using EcoWatch during setup and checkout, you may be able to click on the file of your choice in the most recently opened files.

Once the SAMPLE.DAT file is open you should see a plot, figure 33, which graphically represents seven days of sonde data for six different water quality parameters plotted as a function of date and time. Each set of data is autoscaled to allow you to see the minimum and maximum values for each parameter during the one-week study.

Figure 33 Opening a File



Some daily variations may be noticed in parameters such as dissolved oxygen, pH and temperature in this particular study. This is fairly typical in many natural bodies of water. Note also that conductivity is low at both ends of the graph. You may notice similar perturbations in some of the other readings as well. In this example, the sonde was not in the water for a short time at the beginning and end of the study. Not only can you see exactly when the sonde went in and out of the water, but the bottom graph shows the depth at which the sonde was deployed.

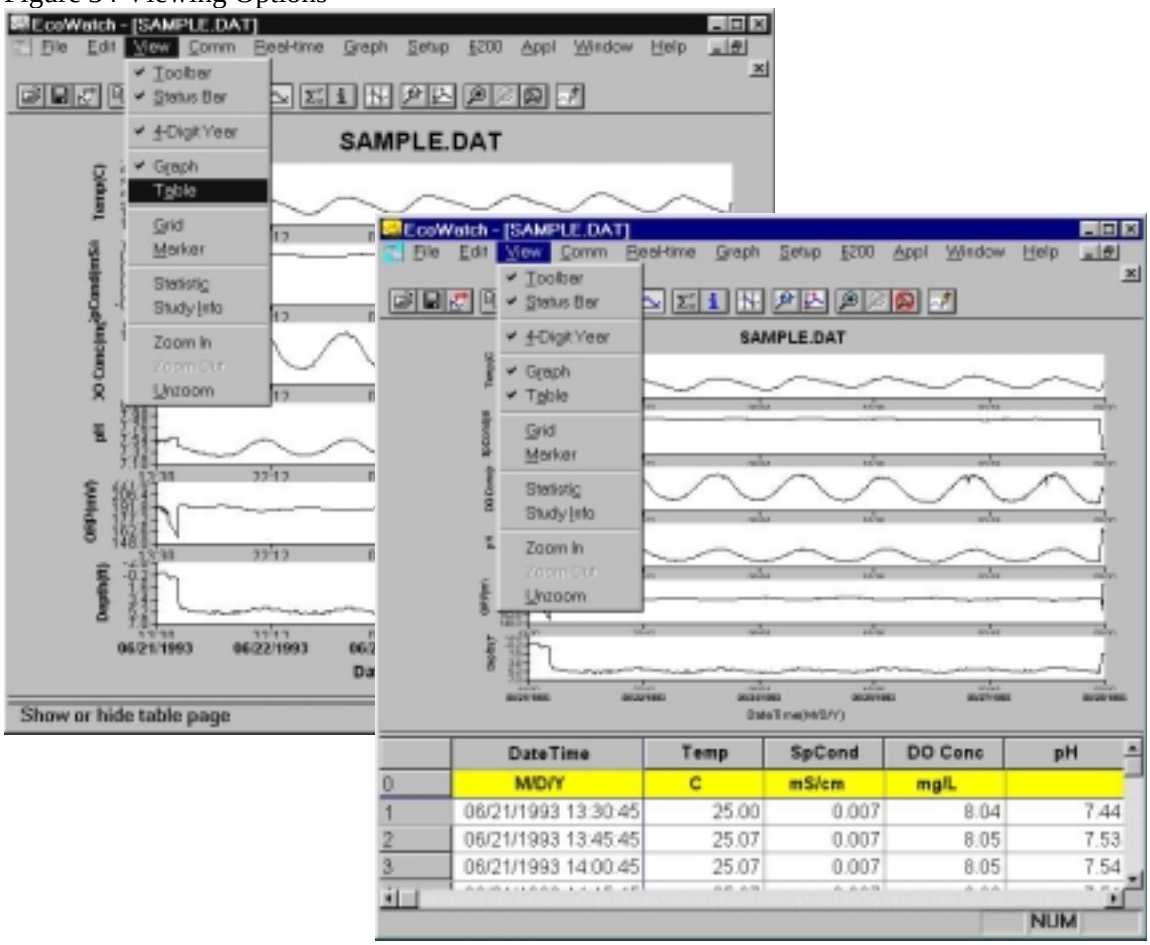
Notice that you now see a new set of menu items in the top line. Some of these functions are specifically related to viewing and manipulating data. Next we will examine some of the viewing options.

VIEWING DATA

To look at some of the viewing options, click on **View**. Note that the Toolbar and Status Bar are turned on (check mark). In addition, the 4-Digit Year expression is checked. Also note that a check mark is just left of the Graph choice. When a check is next to Graph, all data are expressed graphically in the opening window.

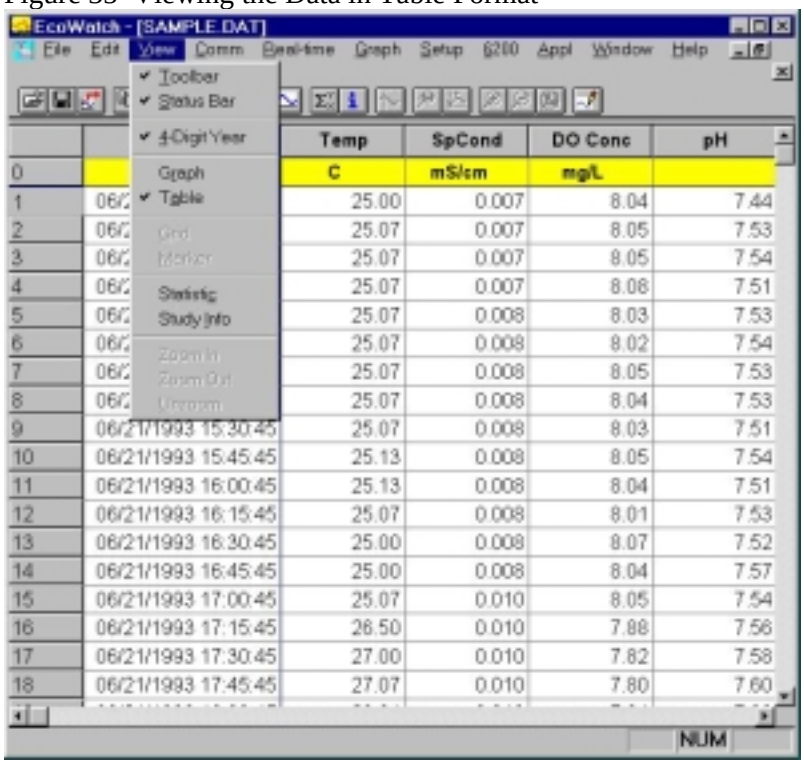
To show data in both graphical and data table format, highlight the Table menu item, then click or press **Enter**. The graphical portion of the window becomes compressed, and the data table becomes visible. If you then click on **View** again, both the Graph and Table items have check marks to their left, indicating that both functions are turned on. You may use your mouse to scroll up/down and left/right to view data.

Figure 34 Viewing Options



It may be somewhat awkward to scan the data table in this manner, therefore you have the option to turn off the graphical representation and allow the table to fill the window, see figure 35. Notice now that when you click on **View**, the Graph item is no longer checked.

Figure 35 Viewing the Data in Table Format



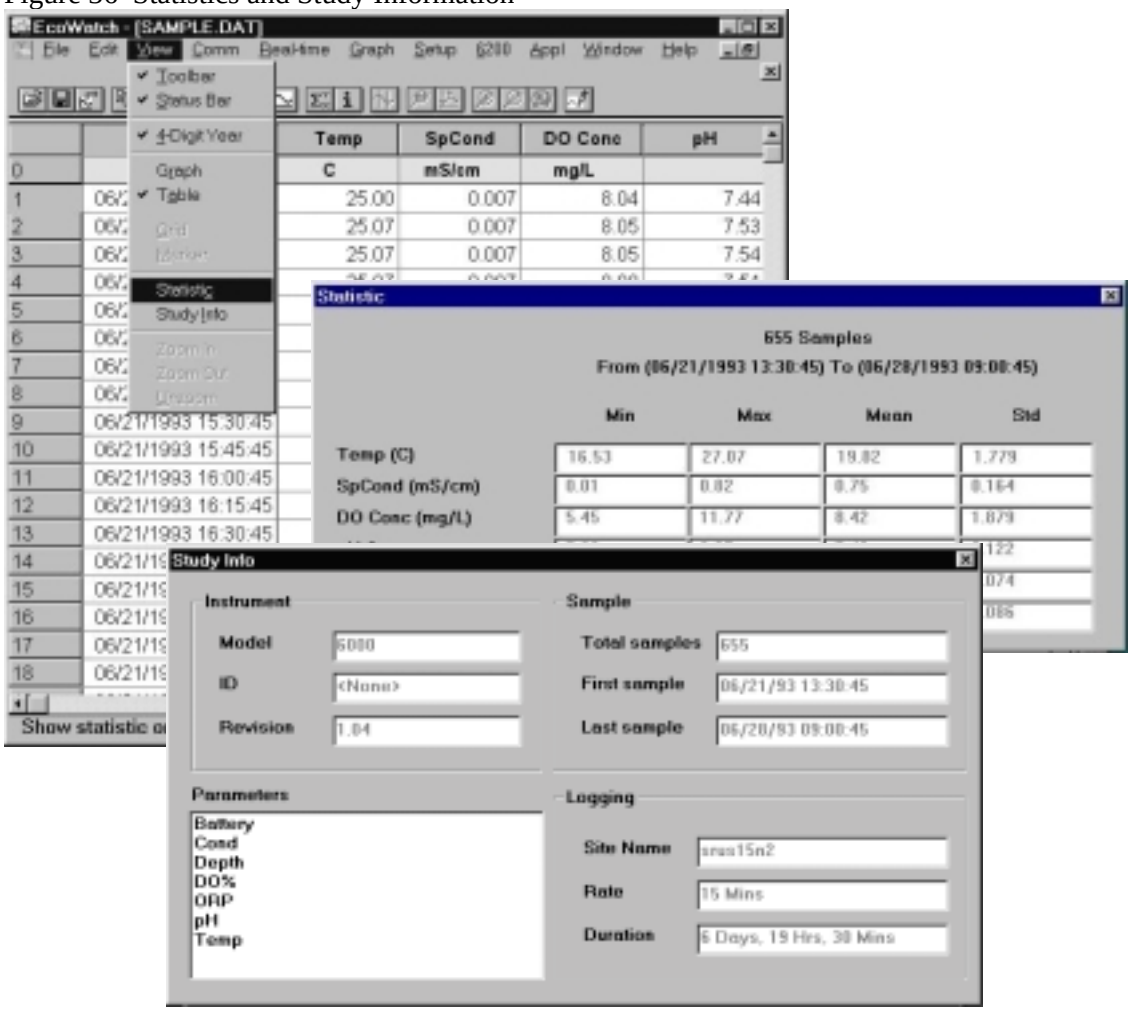
Viewing features such as Grid, Marker, Zoom In, Zoom Out and Unzoom are all available when you activate the **Graph** function. Give each a try as you practice and learn more about the many features of EcoWatch.

The **Statistics** and **Study** functions of EcoWatch are shown in figure 36. Both provide overview information related to the study data. The **Statistics** function lists minimum, maximum, mean and standard deviation information for each parameter activated. The **Study** function provides useful information about the design of the study including sample interval, date/time, number of samples, sensor identification and parameters reported. The Statistics and Study windows may be activated over either graph or table presentations.

To view either of these windows, click on **View**, highlight the desired function and click again. The window opens on top of the table or graph, similar to what is shown in figure 36. Only one of these windows may open at one time. To continue, you must close the Statistics or Study window to return to the graph or table and activate the top line menu again.

As before practice viewing the functions mentioned above to gain more familiarity with these features.

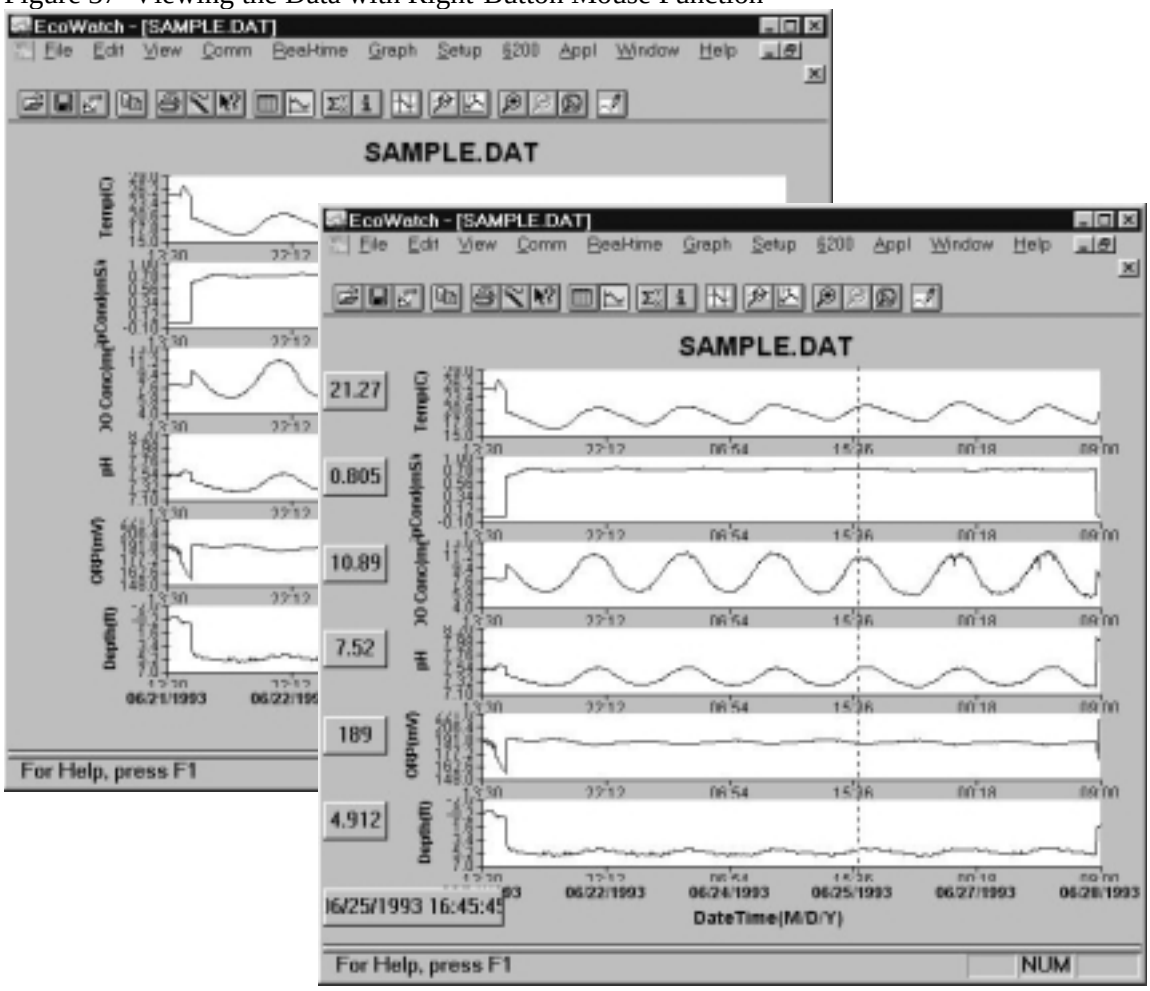
Figure 36 Statistics and Study Information



Next, with the Statistics and Study windows closed, return to the **View** menu, close **Table** and activate **Graph**.

Using the right mouse button, click at any point on the graph. A dotted vertical line appears along with specific data values in boxes to the left of the displayed graphs, as shown in figure 37. You can hold down the right mouse button and move the mouse to scan the entire graph that is displayed in the window. The values in the boxes change as you move the mouse. This feature is very useful for quantifying specific data without the need to open the data table and scroll through what may be thousands of data points. Note also that the exact time and date change to let you know specifically when an event of interest occurred.

Figure 37 Viewing the Data with Right-Button Mouse Function

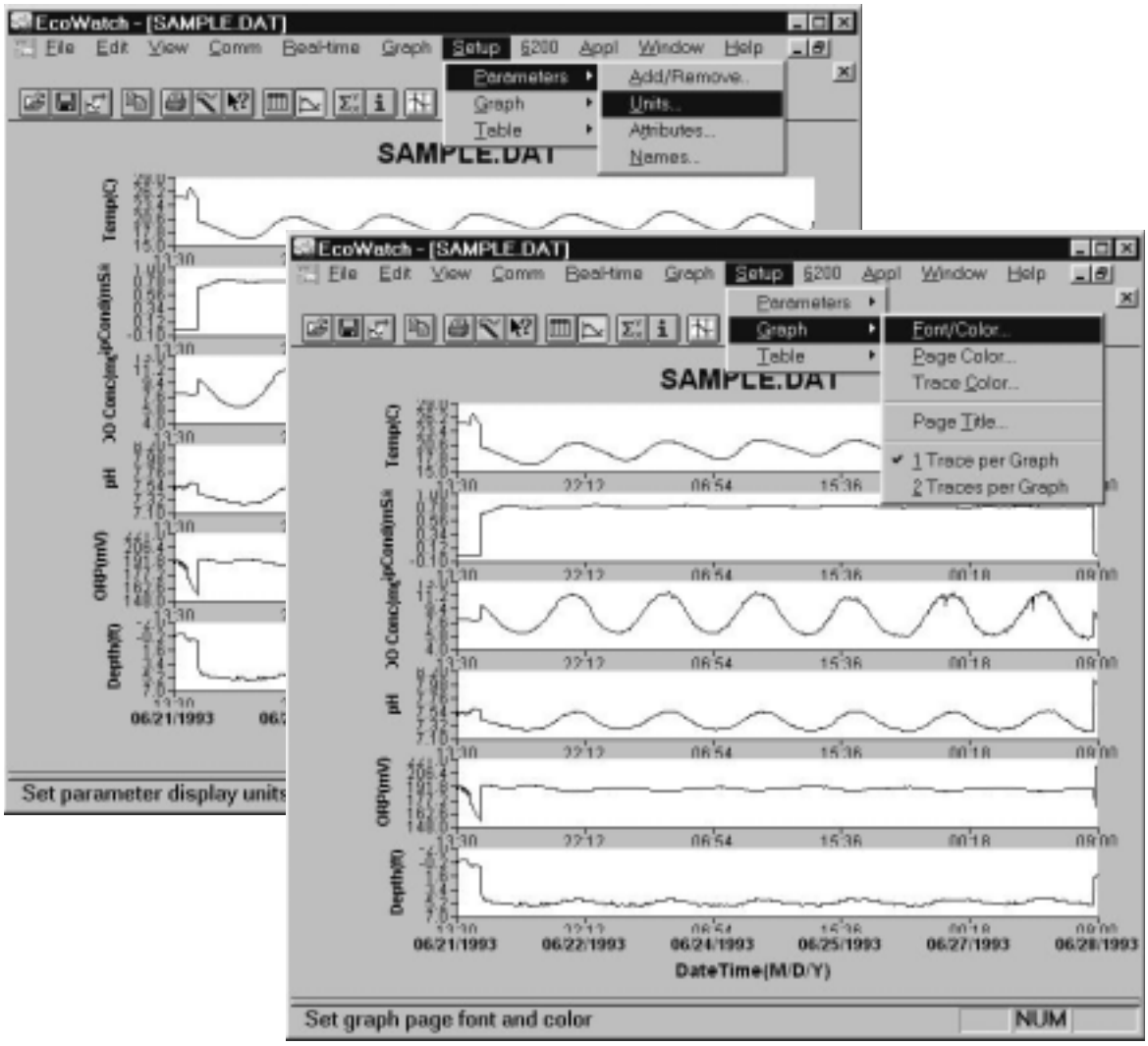


CHANGING DISPLAY FORMATS USING SETUP

Beyond selecting data viewing options such as table format or graphical format, you may also customize your data displays. For example, you may change the order in which parameters are viewed, you may add and delete parameters, you may change plot appearance using different interval times and different units, and you may change the x-axis if you prefer a parameter other than date or time.

The Top Line menu selection that allows you to select some of these parameter changes is **Setup**. Click on **Setup**, then **Parameters**. From here there are four submenus that allow you to Add/Remove parameters, change Units, change sample interval and/or x-axis (Attributes) and change the Names of the parameters you have assigned, as shown in figure 38.

Figure 38 Changing the Appearance of a Graph or Table



If you are displaying the graph, you may change the appearance by changing font, font style, size and text color. You may also change page color, trace color and graph background color. You may assign a custom 2-line title for the graph, and finally, you may display 1 trace or 2 per set of axes. For display of table formatted results you may change font, font style, size and text color. In addition, you may change table color and highlight color.

The menu structure is easy to follow. Try some changes to gain familiarity with these **Setup** display options.

CHANGING DISPLAY FORMATS USING 'GRAPH' FUNCTION

The top line menu labeled **Graph**, as the name suggests, can be used to examine critical events within the graphical format. You may be able to more clearly understand an event by zooming in/out, centering an event of interest, and setting limits to focus in on a specific area of the graph. In addition to modifying along the x-axis, you may also manually scale the y-axis. This may allow you to discard a noise spike and obtain better resolution of events unrelated to the noise. Functions like Autoscale, Redraw and Cancel Limits are all used to "undo" some of the customization functions. Below in figure 39 you see some of these functions.

One very commonly used function is **Limit Data Set**. If you choose this function by clicking on the highlighted item as shown below, you then use the mouse to move your cursor to the left limit of an area of interest, click once, then move the mouse to the right limit of interest and click again. The result will be a close up look at the specific area of the graph you have defined. Refer to figure 39 and 40 below to see the results of this particular feature.

Figure 39 Selecting a Subset of Data within a Graph

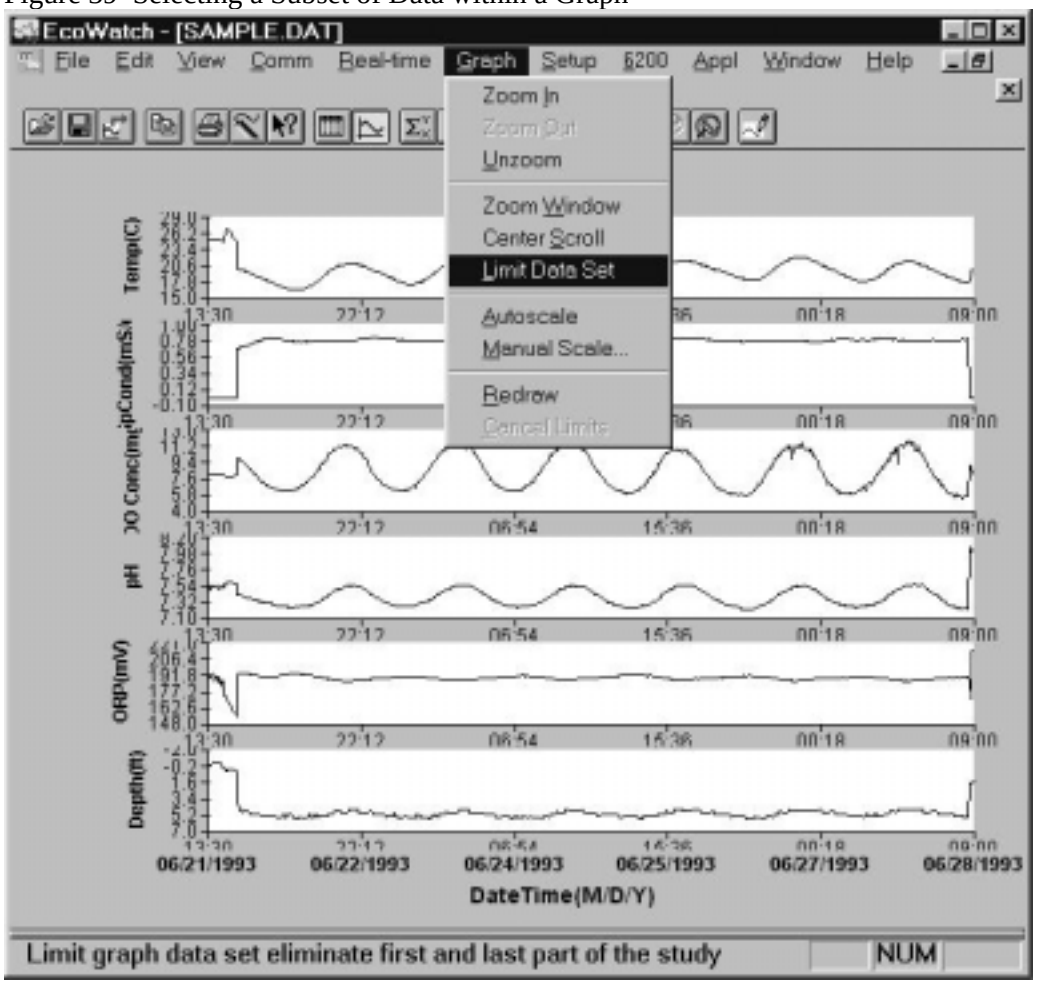
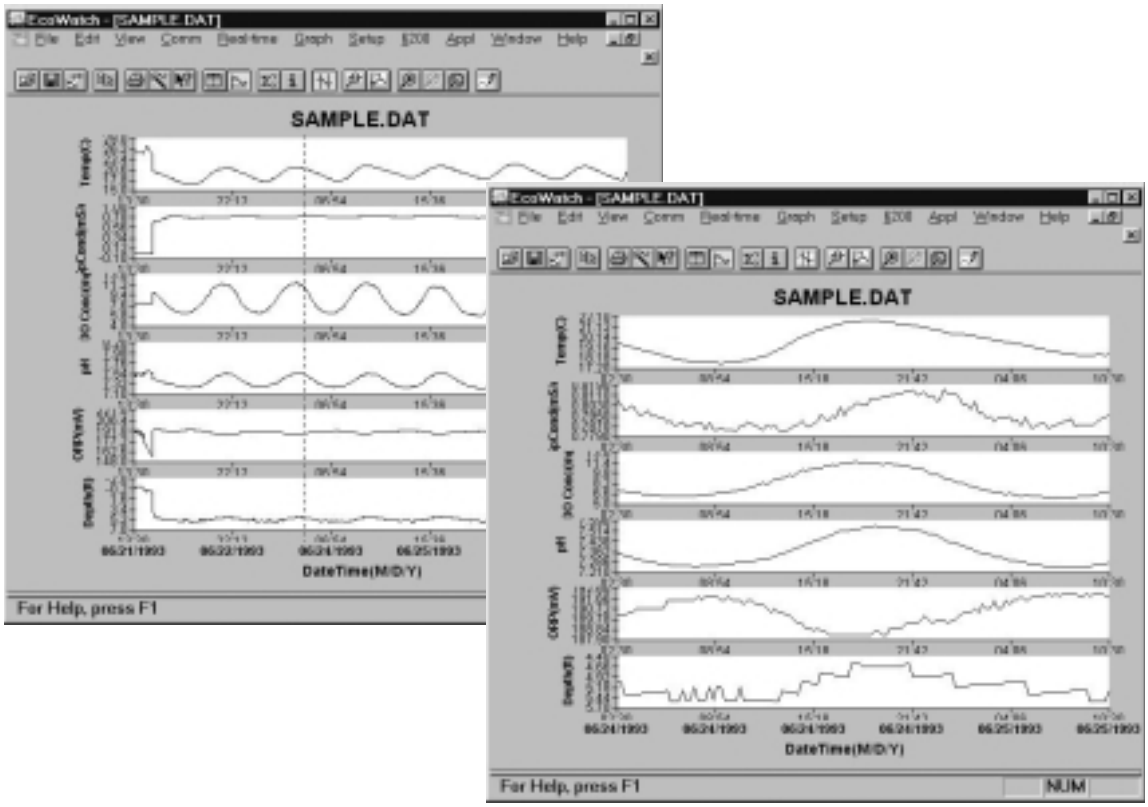


Figure 40 Using Limit Data Set to Display a Subset of Data

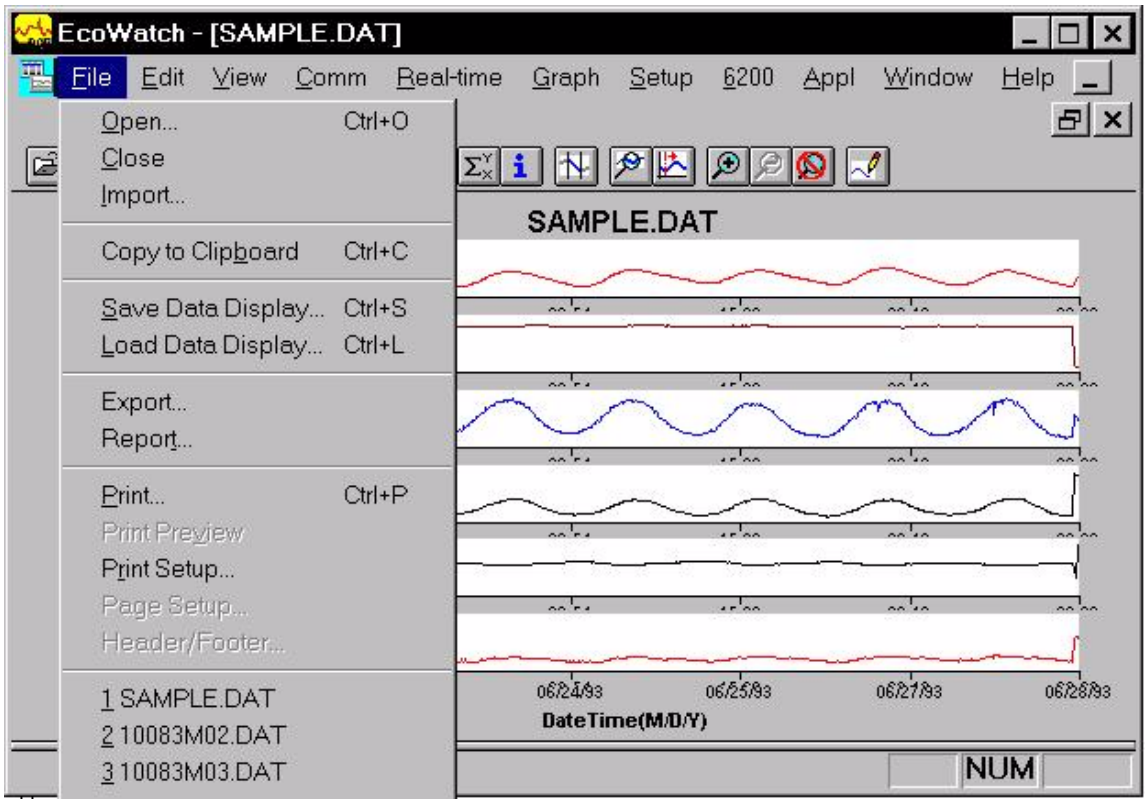


To return to the full set of data again, click on **Graph**, then **Cancel Limits**. If you desire a hard copy of any graph or table, or even a subset expression as shown above, you may use the **Edit, Copy** command to 'copy' the graph in the active window to the "Clipboard". You can then 'paste' this graph to the Windows application program of your choice. You may also be able to print graphs and tables as described in the next section.

SAVE, IMPORT, EXPORT AND PRINT COMMANDS

Under **File** function in the top line menu, you can save a particular .DAT file that you have customized, and rename it if you like. You may export it as a .CDF file or print it to a compatible printer. You may create a .RPT (report). You may save a data format that you have created and recall it in the future. With this function you can create several formats, save them and load them as you need in the future. See Figure 41 for the **File** menu, which includes some of these commands. Use the Window's Help function to learn more about these features.

Figure 41 Saving, Exporting, Printing and Related Functions



EXAMPLE OF CUSTOMIZING A SUBSET OF SAMPLE.DAT

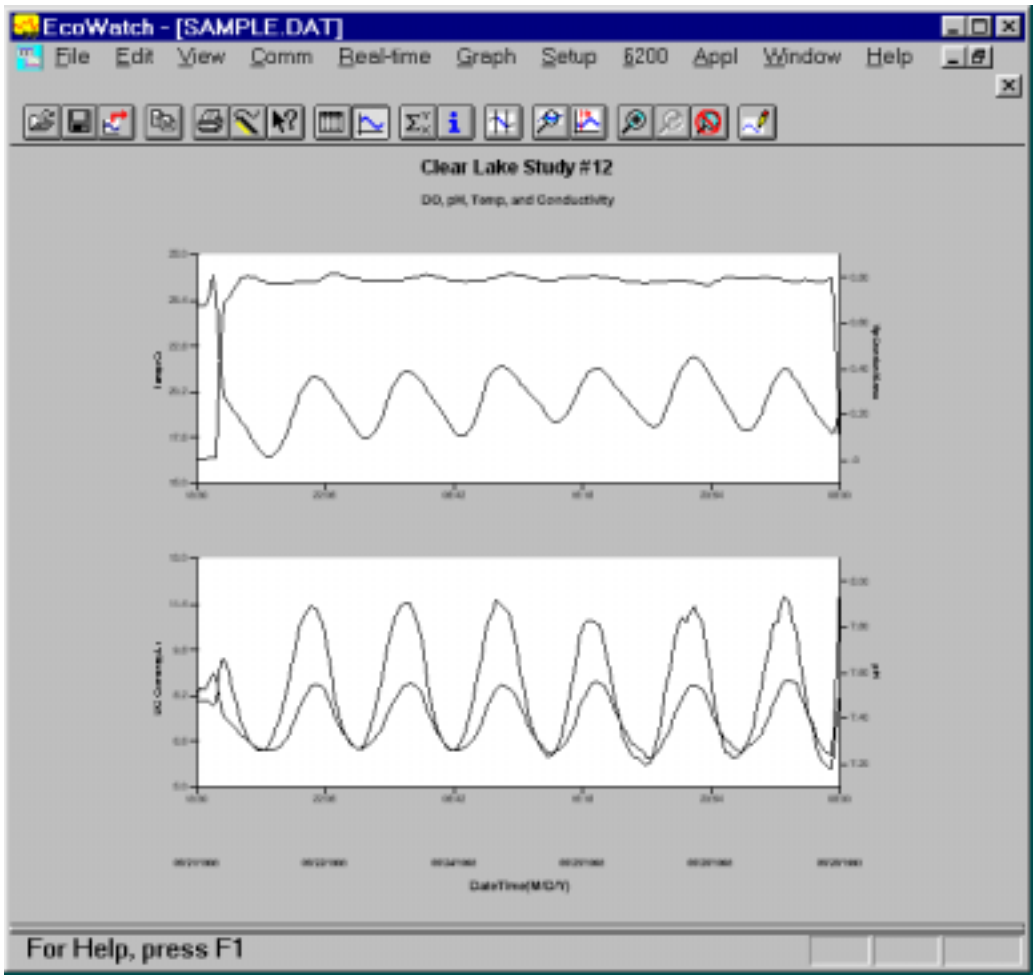
To conclude this section we have used a few of the many tools available in EcoWatch to demonstrate how you might use this powerful plotting and reporting program to express study results. We encourage you to try some of the tools and learn more about EcoWatch by using the Window's Help function, which is available when the EcoWatch program is running.

Using SAMPLE.DAT we decided that some of the data were not of particular interest, so using top line menu item **Setup**, then Parameters, then **Add/Remove,** we removed ORP and Depth results from the data set. Note that we have not deleted this information from the file, but rather we are choosing not to display it. You can always return to this function and add original data back. Under the same **Parameters** function, we have selected **Attributes** and changed the Average Interval from the default **0** to **60**. Since data was collected every 15 minutes, the change to a 60 minute interval helps to smooth out the graph and average out any short term "noise" events.

Next, we again select **Setup**, then **Graph**. From the functions available, we first selected Title Page… and typed in a name (Clear Lake Study #2) and below that we typed the parameters that are shown in the graph. Just below **Title Page,** we clicked on **2 Traces per Graph**. This combines adjacent parameters which is sometimes useful in parameter and event evaluation. For

example, in the second graph shown in Figure 42 below, you see that DO concentration and pH seem to track rather closely and change in a diurnal rhythm. In actuality, when DO levels drop in a natural body of water, CO_2 often builds up forming carbonic acid which leads to lower pH readings. DO rises again during the day due to photosynthesis, CO_2 then falls and pH increases again.

Figure 42 Customizing a Graph from SAMPLE.DAT



As you become more familiar with EcoWatch for Windows, the plotting, analysis and reporting functions can be accomplished easily and quickly. Practice with all of the functions and, again, do not forget to use Window's Help for more detail, or see Section 4, **EcoWatch for Windows**.

2.9 SONDE MENU

The functions of the sondes are accessible through the sonde menu. The sonde menu structure makes it simple and convenient to select functions. This section provides a description of the menus and their capabilities.

When moving between menus within the sonde software structure, use the **0** or **Esc** to back up to the previous menu. To exit menus and return to the sonde command line (the # sign), press **0 or Esc** until the question "**Exit menu (Y/N)?"** appears. Type **Y** and press **Enter**. To return to the Main sonde menu, type **menu** and press **Enter.**

IMPORTANT MESSAGE!
WHAT IF THERE IS NO RESPONSE TO A KEYSTROKE?

To save power, the sondes will power down automatically if no interaction from the keyboard occurs for approximately 60 seconds when an Autosleep function (RS232 or SDI12) is activated in the **Advanced Setup** menu. When the software is in this "sleep" mode, the first subsequent keystroke simply "wakes it up" and has no visible effect on the display. The next keystroke after the unit is "awakened" will be input to the software in the intended manner. Thus, if you press a key after the sonde has been inactive for some time and nothing seems to happen, press the key again.

To gain experience with the sonde menus, select the sonde icon in EcoWatch for Windows and press **Enter**. See figure 32 for the Sonde Menu Flow Chart.

In the following subsections you will learn about the functions of the various menu items and when to use them. The discussion of the menu and submenu functions is organized in numerical order, beginning with **Section 2.9.1 RUN**.

2.9.1 RUN

- Select number **1-Run** from the Main menu to begin taking readings or to set/verify the parameters required for a study. There are two options in the Run menu.

```
---------------Run setup--------------
1-Discrete sample
2-Unattended sample

Select option (0 for previous menu): 1
```

DISCRETE SAMPLING

Discrete sampling is usually used in short term, spot sampling applications when the user is present at the site and the unit is attached to a data logger or laptop PC. It could be used in the

vertical profiling of a lake or river where the user lowers the sonde incrementally into the water, and data acquired for a few minutes at each depth. In this section, you will learn how to use the sonde menu structure to open and close files, set the interval between samples, start the sampling operation, and log data to the internal memory of the sonde.

- Select number **1-Discrete sample** from the Run menu. The Discrete sample menu will be displayed.

```
------------Discrete sample------------
1-Start sampling
2-Sample interval=4
3-File=
4-Site=
5-Open file

Select option (0 for previous menu):
```

- Select number **1 – Start sampling** option to start discrete sampling. After the initial sampling time interval has passed (4 seconds in the screen above), sequential lines of data will appear on the screen.

```
=========================================================================
    Date     Time  Temp SpCond    Sal  DO     Depth    pH   Turbid  Battery
mm/dd/yy hh:mm:ss     C  mS/cm    ppt  mg/L    feet           NTU   volts
-------------------------------------------------------------------------
*** 1-LOG last sample   2-LOG ON/OFF,  3-Clean optics***
05/05/97 10:04:40 21.57  0.009   0.00  7.73  -0.293  7.55        0.3     10.2
05/05/97 10:04:44 21.57  0.009   0.00  8.41  -0.300  7.55        0.3     10.3
*** LOG is ON,  hit 2 to turn it OFF,  3-Clean optics***
05/05/97 10:04:48 21.58  0.009   0.00  8.41  -0.302  7.55        0.3     10.3
05/05/97 10:04:52 21.58  0.009   0.00  8.40  -0.302  7.55        0.3     10.3
05/05/97 10:04:56 21.58  0.009   0.00  8.41  -0.303  7.55        0.3     10.2
05/05/97 10:05:00 21.58  0.009   0.00  8.42  -0.303  7.55        0.3     10.3
*** 1-LOG last sample   2-LOG ON/OFF ,  3-Clean optics***
05/05/97 10:05:04 21.58  0.009   0.00  8.44  -0.304  7.55        0.3     10.3
Sample logged.
05/05/97 10:05:08 21.58  0.009   0.00  8.45  -0.305  7.55        0.3     10.3
```

The following prompt will appear just below the screen header:
1-LOG last sample, 2-LOG ON/OFF, 3-Clean optics

- By entering **1–LOG last sample**, A single line of data can be logged to flash disk (sonde) memory and the following message will be displayed: **Sample logged.**

- By entering **2-LOG ON/OFF**, a set of data can be logged to memory and the following message will be displayed: **LOG is ON, hit 2 to turn it OFF, 3-Clean optics.** Press **2** again to terminate logging.

- By entering **3-Clean optics**, if your unit has an optical (chlorophyll or turbidity) probe (with wiper) installed and enabled, the wiper will clean the optical surface**.** The **3-Clean optics** portion of the prompt will only appear if an optical probe was installed and enabled.

Select **Esc** or press **0** and return to the Discrete Sampling menu.

- From the Discrete Sampling menu, select number **2-Sample Interval** to type a number that represents the number of seconds between samples. The maximum sample interval is 32767 seconds (9+ hours). The factory default sample interval is 4 seconds and works best for most discrete sampling applications. The shortest possible sample interval for obtaining new DO readings is 4 seconds. If a smaller interval is selected, then the DO readings remain constant for the number of samples necessary to fill 4 seconds.

Sampling Faster Than 0.5 Seconds

For special applications, your sonde is capable of faster sampling. The only limitation is a reduction of the number of sensors selected. To determine the maximum sampling frequency for your sensor setup, divide 36 by the number of enabled sensors in addition to the DO sensor.

Example:
If you enable any three sensors plus DO, divide 36 by 3 to obtain 12 samples/second (12 Hz) or 0.083 seconds between samples as the maximum sampling frequency. Remember that for sample intervals less than 4 seconds, DO readings are updated only every 4 seconds. Thus, at 12 Hz, the display will show 48 identical DO readings before a change occurs. Note also that at a faster sampling rate, consecutive readings are closer together, the threshold for any one sensor is less likely to be exceeded, and the data filter is less likely to disengage. For these applications you may want to adjust your threshold settings accordingly. See section 2.9.8 for more information on the data filter.

- Select number **3 -File** to enter a filename with a maximum of 8 characters. You will log readings to the filename that you enter.

If you started sampling without entering a filename, the default name NONAME1 will be assigned to your file. Whenever you press **1-LOG last sample** or **2-LOG ON/OFF** from the menu, NONAME1 will be opened during sampling. If this happens, and you want to restart the file with a different name, press **5-Close file** and rename the file.

- Select number **4-Site** to assign a site name with a maximum of 31 characters This allows you to enter the name of the site where you are sampling.

- When you select number **5-Open File**, a file is opened and the number 5 changes to **Close File**. When you are finished logging data to the file, press **5-Close File** and number 5 changes back to **Open File**. When you start logging it changes automatically.

Now select number **1-Start sampling** to start discrete sampling.

After the initial sampling time interval has passed, sequential lines of data will appear on the screen.

In the screen above, both the logging of a set and a single line of data are shown. When logging is not active, you may press **1-LOG last sample** to capture a single line of data. The message "**Sample logged**" verifies that the previous line was logged to memory.

UNATTENDED SAMPLING

This option is used for long-term deployment of the battery-powered sonde when the user is not present at the site. Prior to this selection, the sonde is usually attached to a computer in a laboratory and set up to automatically log data to sonde memory at a fairly long time interval (15-60 minutes). The unit is then taken to the field site and left for an extended time period (30 – 60 days). When the study is complete, or the batteries are expended, the unit is brought back to the laboratory and the data file is uploaded to a computer. Quality assurance checks are performed prior to redeployment.

Select number **2-Unattended Sampling** from the Run menu. The Unattended sample menu will be displayed. Use the following example to understand the unattended sampling option.

```
------------Unattended setup----------
1-Interval=00:15:00
2-Start date=07/17/96
3-Start time=18:00:00
4-Duration days=14
5-File=clrlake3
6-Site=Clear Lake at Spillway
7-Bat volts: 9.1
8-Bat life 21.2 days
9-Free mem 18.9 days
A-1st sample in 8.10 minutes
B-View params to log
C-Start logging
```

Follow the prompts on this screen to prepare your 600XLM, 6600 or 6920 sonde for unattended deployment as described below:

- Verify that the current time and date are correct to ensure that your unattended sampling study begins and ends when you desire. To verify and/or correct the time and date enter **4-Status** or **5-System menu** from the main menu. You may enter the correct date and time from either of these submenus.

- Select number **1-Interval** and enter the desired time between samples. Use the 24-hour clock format to enter interval.

- Select number **2-Start Date** and number **3-Start Time** to set the time that data will begin to log to sonde memory. If you do not make any change to these entries, then the study will automatically begin at the next integral time interval, once you have pressed **C-Start logging**.

  Example: If the current time is 17:20:00 and your sample interval is 15 minutes, logging will automatically begin at 17:30:00.

It is better to start the study prior to taking the unit to the field so that you can confirm that readings are being saved to memory. If you should desire to start the instrument at the site at 6:00 PM, change the Start Time to 18:00:00.

- Select number **4-Duration** and set the length of the study in days. The default value is 365 days (which is longer than most deployments). In most cases, you will either want to stop the unattended study manually or allow the batteries to be expended. It is wise to set the duration to a value longer than the anticipated deployment. If you cannot retrieve the sonde at the expected time due to factors beyond your control such as weather or illness, data will continue to be acquired as long as battery power is present.

- Select **5-File** and enter a name of no more than 8 characters that will be used by your external computer to identify the study.

- Select **6-Site** and enter a site name of no more than 31 characters. This filename will appear in your sonde file directory, but will not be used to identify the file after transfer to your computer.

- Check **7-Battery** to make certain that the voltage is suitable for the length of the study that you are about to begin. No change can be made to this item via the software. Note that no battery entry will appear for the 600R, 600XL, and 6820 sondes.

- Select **B-View Parameters to log** to confirm that your sensor and report setups are configured correctly. An example screen is shown below.

```
------------Params to log------------
1-Temp C            6-Orp mV
2-Cond mS/cm        7-NH4+ N mg/L
3-DOsat %           8-NO3- N mg/L
4-DOchrg            9-Turbid NTU
5-pH                A-Battery volts

Select option (0 for previous menu):
```

In some cases, the **View params to log** screen only identifies the raw parameters that are used in the calculation of the items that you have selected in the Report setup.

Example: You have selected DO mg/L in the Report setup, but it does not appear under **View parameters to log** because it is calculated from DO saturation %,Temperature, and Conductivity. Likewise, although specific conductance is selected in the Report setup, it does not appear under **Parameters to log** because it is calculated from Conductivity and Temperature. In all but a few cases, the proper configuration of **Parameters to log** will be automatically set up as long as the sensor is enabled.

There are several items that must be activated in the Report setup so they will be available from the file after upload. These special parameters are: DO Chg, pH mV, $NH4^+$ mV, $NO3^-$ mV, Cl^- mV, and Fluoresence %FS. If you want to log any of these parameters to your data file, be certain that they are active in the Report setup before you begin the unattended study.

After making the above entries, the sonde software will automatically estimate the expected battery life, and the time it will take for the sonde memory to be filled. This information is displayed on the screen for your consideration as items 8, 9, and A. If the battery life or the free memory capacity will be exceeded sooner than the duration, you may want to make some changes to the entries. For example, you can free up memory in the sonde by uploading all existing data from the sonde memory to your PC and then deleting them out of the sonde (see **3-File** from Main Menu). You may want to change the batteries for longer battery life. You can lengthen the sampling interval to extend both battery life and memory capacity.

The predicted battery life is an estimate only. The temperature of the site and the brand of batteries used can affect battery life. It is better to recover the sonde earlier than the predicted battery life, and to use new batteries for each deployment.

Once you press **C-Start logging**, the following screen will appear.

```
-------------Start logging-------------
Are you sure?
1-Yes
2-No

Select option (0 for previous menu):
```

Select number **1-Yes** and the screen will change.

```
----------------Logging---------------
1-Interval=00:15:00
2-Next at 07/17/96
3-Next at 18:00:00
4-Stop at 07/31/96
5-Stop at 18:00:00
6-File=clrlake3
7-Site=Clear Lake at Spillway
8-Bat volts: 9.0
9-Bat life 21.2 days
A-Free mem 18.9 days
B-Stop logging

Select option (0 for previous menu):
```

The display now shows the next date and time for logging and the stop date and time for the logging study. Most importantly, note that the bottom command now shows **B-Stop logging**, a confirmation that the logging has indeed been initiated.

The Unattended study will terminate when the duration you specified has expired or the batteries are expended. If you want to terminate sooner, simply select **2-Unattended** sample from the Run menu, then **B-Stop logging**. Select **1-Yes** and return to the Unattended setup menu.

```
Stop logging?
1-Yes
2-No

Select option (0 for previous menu):
```

2.9.2 CALIBRATE

All of the sonde sensors (except temperature) require periodic calibration to assure high performance. However, the calibration protocols for dissolved oxygen are significantly different depending on whether the sonde is being set up for spot sampling or longer term unattended monitoring studies. This difference is user-selectable and is required primarily because the optimal performance of the Rapid Pulse dissolved oxygen sensor cannot be attained unless the control of this sensor varies from short term to long term applications.

For spot sampling it is best to pulse the sensor continuously during the Run mode to attain the most accurate results and optimize the response time. However, this continuous pulsing is not ideal for longer term logging studies in which the sonde data is captured to sonde memory or to a data collection platform at much less frequent intervals (e.g. 15 minutes). Continuous pulsing not only shortens the time between required probe maintenance, but consumes more power. With

proper selection of the "Auto sleep" option (discussed in detail in **Section 2.9.8, Sonde Menu**), the user can configure the sonde software to either run continuously or "go to sleep" between samples to minimize DO probe wear and conserve power. The effect of this choice on the user interface relative to dissolved oxygen calibration is significant as described below:

- If "Auto sleep" is **deactivated**, the sonde runs continuously no matter what sample interval has been selected. Under these conditions, you retain manual control of the dissolved oxygen calibration routine, viewing the stabilization of the readings in real time and confirming the calibration with keyboard entries.

- If "Auto sleep" is **activated**, the sonde will 'warm up' the sensors for the period of time selected for the DO sensor. Under these conditions, you lose manual control of the DO calibration routine. DO will automatically calibrate after the selected time for warm up of the DO sensor has expired. In this mode of calibration, you do not observe stabilization of the readings in real time, but instead will observe a countdown of the warm up period followed by a message indicating that the DO calibration is complete.

Only the calibration of dissolved oxygen is affected by whether "Auto sleep" is on or off; the user retains manual control of the calibration of all other parameters regardless of the "Auto sleep" setting. Once warm up time has been utilized in DO calibration, the length of that time should not be changed during a study. A new calibration should be performed whenever the value of the warm up time is altered.

From the Main sonde menu select **2-Calibrate**. The Calibrate menu will be displayed. Only the enabled parameters will be available for calibration.

```
---------------Calibrate-------------
1-Conductivity      6-ISE3 NH4+
2-Dissolved Oxy     7-ISE4 NO3-
3-Pressure-Abs      8-ISE5 Cl-
4-ISE1 pH           9-Turbidity
5-ISE2 ORP          A-Chlorophyll

Select option (0 for previous menu):
```

CONDUCTIVITY

Select number **1 - Conductivity** to calibrate the conductivity probe and a second menu will offer you the options of calibrating in specific conductance, conductivity, or salinity. Calibrating any one option automatically calibrates the other two. After selecting the option of choice (specific conductance is normally recommended), you will be asked to enter the value of the standard used during calibration. Be certain that the units are correct. After pressing **Enter**, you will be able to follow the stabilization of the readings and confirm the calibration when the readings are stable by pressing **Enter** as instructed on the screen. Then, as instructed, press **Enter** again to return to the Calibrate menu.

DISSOLVED OXYGEN WITH AUTOSLEEP ON

If you intend to do Unattended Sampling, it is recommended that you turn Autosleep on and follow these instructions for DO calibration. If you intend to do Discrete Sampling, it is recommended that you turn Autosleep off and use the calibration instructions in the next section.

Select number **2 - Dissolved oxygen** to calibrate the oxygen probe. The submenu will offer you the option of calibrating in percent saturation or mg/L. After selecting the option of choice (percent saturation in water-saturated air is normally recommended), you will be prompted for the next step. Calibrating either of the choices will automatically calibrate the other.

For the percent saturation mode, be certain that the sensor has been thermally equilibrated in water-saturated air and that the sensor has stabilized prior to beginning the calibration routine, particularly after a membrane change. Relieve pressure in the cup if necessary.

Remember, the Calibration Cup is designed to be air-tight and must be loosened if it is used as a calibration chamber. See **Section 2.6, Calibration** for more details. Follow the screen prompt and enter the local barometric pressure in mm Hg, (inches Hg x 25.4), press **Enter**, and the calibration will automatically occur after the warm-up time which has been selected by the user (default is 40 seconds). Then, as instructed, press **Enter** again to return to the Calibrate menu.

For the mg/L mode, calibration is carried out in a water sample which has a known concentration of dissolved oxygen, usually determined by Winkler titration. For this calibration procedure, the sensor should be immersed in the water. After thermal equilibration, enter the known mg/L value, press **Enter**, and the calibration procedure will be carried out automatically as for the percent saturation mode above.

DISSOLVED OXYGEN WITH AUTOSLEEP OFF

If you intend to do Discrete Sampling, it is recommended that you turn Autosleep off and follow these instructions for DO calibration. If you intend to do Unattended Sampling, it is recommended that you turn Autosleep on and using the calibration instructions in the preceding section.

Select the **Dissolved Oxygen** option from the Calibrate menu to calibrate the oxygen probe. The submenu will offer you the option of calibrating in percent saturation or mg/L. After selecting the option of choice (percent saturation in water-saturated air is normally recommended), you will be prompted for the next step. Calibrating either of the choices will automatically calibrate the other.

For the percent saturation mode, be certain that the sensor has been thermally equilibrated in water-saturated air and that the sensor has stabilized prior to beginning the calibration routine, particularly after a membrane change. Relieve pressure in the cup if necessary. Remember, the Calibration Cup is designed to be air-tight and must be loosened if used as a calibration chamber. Then follow the screen prompt and enter the local barometric pressure in mm Hg, (inches Hg x 25.4), press **Enter**, and monitor the stabilization of the DO readings. After no changes occur for

approximately 30 seconds, press **Enter** to confirm the calibration. Then, as instructed, press Enter again to return to the **Calibrate** menu.

For the mg/L mode, calibration is carried out in a water sample which has a known concentration of dissolved oxygen, usually determined by a Winkler titration. For this calibration procedure, the sensor should be immersed in the water. After thermal equilibration, enter the known mg/L value, press **Enter**, and the calibration procedure will begin with similar viewing of stabilization and confirmation of calibration as for the percent saturation mode above.

NOTE: If you have resurfaced your DO sensor, we recommend running the probe continuously for 15-30 minutes or until good stability is realized. After a membrane change only, run the probe continuously for 3-4 minutes or until good stability is realized.

PRESSURE – ABS AND GAGE

Select number **3 - Pressure – Abs (non-vented) or Gage (vented)** to zero the depth sensor. The depth sensor is factory calibrated, but it is always necessary to zero the absolute sensor relative to the local barometric pressure. A minor correction is sometimes necessary to set Gage to exactly 0.000 feet. The zeroing procedure should be carried out with the sonde in air for this initial calibration. Alternatively, you may set zero or an offset while the sonde is submersed for "relative depth" applications. After the depth option is selected, enter 0.00 (or other appropriate number) at the prompt, press **Enter** and monitor the stabilization of the depth readings. After no changes occur for approximately 30 seconds, press **Enter** to confirm the calibration. As instructed, press **Enter** again to return to the Calibrate menu.

Zeroing the depth sensor by the above protocol (entering 0.00 at the screen prompt) will result in a measurement of the distance between the water surface and the ports of the depth module. In order for the observed depth readings to reflect the distance between the water surface and the actual probe array, measure the length between the upper hole and the bottom of the standard 6-inch sonde guard. Enter the length at the screen prompt instead of 0.00.

For best performance of depth measurements, users should ensure that the sonde's orientation remains constant while taking readings. This is especially important for vented level measurements and for sondes with side mounted pressure sensors.

pH

When selecting number **4 – ISE1-pH**, you will be given the choice of 1-point, 2-point, or 3-point calibrations.

Select the **1-point** option only if you are adjusting a previous calibration. If a 2-point or 3-point calibration has been performed previously, you can adjust the calibration by carrying out a one point calibration. Immerse the sonde in a buffer of known pH value and press **Enter.** You will be prompted to type in the pH value of the solution. Press **Enter** again, and the screen will display real-time readings that will allow you to determine when the pH and temperature readings have stabilized. Pressing **Enter** will confirm the calibration. Then, as instructed, press **Enter** again to return to the Calibrate menu. This calibration procedure adjusts only the pH offset and leaves the previously determined slope(s) unaltered.

Select the **2-point** option to calibrate the pH probe using only two calibration standards. In this procedure, the pH sensor is calibrated using a pH 7 buffer and pH 4 buffer. A two point calibration procedure (as opposed to a 3-point procedure) can save time if the pH of the media being monitored is known to be either basic or acidic. For example, if the pH of a pond is known to vary between 5.5 and 7, a two-point calibration with pH 7 and pH 4 buffers is appropriate. Three point calibration with an additional pH 10 buffer will not increase the accuracy of this measurement since the pH is not within this higher range.

To begin the calibration, immerse the sonde in one of the buffers and enter the actual pH value. Press **Enter**, and the screen will display real-time readings that will allow you to determine when the pH sensor has stabilized. Pressing **Enter** will confirm the calibration. Following the instructions on the screen, place the sonde in the second pH buffer, input the pH value, press **Enter**, and view the stabilization of the values on the screen in real time. After the readings have stabilized, press **Enter** to confirm the calibration. Then, as instructed, press **Enter** again to return to the Calibrate menu.

Select the **3-point** option to calibrate the pH probe using three calibration solutions. In this procedure, the pH sensor is calibrated with a pH 7 buffer and two additional buffers. The 3-point calibration method assures maximum accuracy when the pH of the media to be monitored cannot be anticipated. The procedure for this calibration is the same as for a 2-point calibration, but the software will prompt you to select a third pH buffer to complete the 3-point procedure.

ORP

Select number **5 - ISE2-ORP** to calibrate the ORP sensor. Immerse the sonde in a solution with a known oxidation reduction potential value (we recommend Zobell solution) and press **Enter.** You will be prompted to enter the ORP value of the solution. Press **Enter**, and monitor the stabilization of the ORP and temperature readings. After no changes occur for approximately 30 seconds, press **Enter** to confirm the calibration. Then, as instructed, press **Enter** again to return to the Calibrate menu.

The following calibrations are for the 6820, 6600 or 6920 sondes only. If you do not have one of these sondes, skip to Section 2.9.6, Report.

AMMONIUM

When selecting number **6 – ISE3-NH4+,** you will be given the choice of 1-point, 2-point, or 3-point calibrations for your ammonium (NH_4^+) sensor.

Select the **1-point** option only if you are adjusting a previous calibration. If a 2-point or 3-point calibration has been performed previously, you can adjust the calibration by doing a one point calibration. Immerse the sonde in any solution of known ammonium concentration and press **Enter.** You will be prompted to type in the NH_4^+ value (in mg/L of NH_4-N) of the solution you are using. Press **Enter** again, and the screen will display real-time readings which will allow you to determine when the NH4+ readings have stabilized. Pressing **Enter** will confirm the calibration.

Select the **2-point** option to calibrate the NH_4^+ probe using only two calibration standards which are both at approximately the temperature of your environmental sample. In this procedure, the NH_4^+ sensor is usually calibrated using solutions which contain 1 and 100 mg/L of NH_4-N . Be certain that the calibration solution and sensor are thermally equilibrated prior to entering NH_4^+ values.

To begin the calibration immerse the sonde in the 1 mg/L standard, press **Enter**, input the NH_4-N value, and again press **Enter.** The screen will display real-time readings which will allow you to determine when the sensor has stabilized. Pressing **Enter** will confirm the first calibration. Following the instructions on the screen, place the sonde in the second NH_4^+ standard, press **Enter**, input the correct concentration value, again press **Enter**, and view the stabilization of the values on the screen in real time. After the readings have stabilized, press **Enter** to confirm the calibration. Then, as instructed, press any key to return to the Calibrate menu.

Select the **3-point** option to calibrate the NH_4^+ probe using three calibration solutions, two at ambient temperature and one at a temperature significantly different from ambient. The 3-point calibration method should be used to assure maximum accuracy when the temperature of the media to be monitored cannot be anticipated. The procedure for this calibration is the same as for a 2-point calibration, but the software will prompt you to place the sonde in the additional solution to complete the 3-point procedure. Be certain that the calibration solution and sensor are thermally equilibrated prior to proceeding with the calibration. The recommended order of calibration standards is (1) 100 mg/L standard at ambient temperature, (2) 1 mg/L standard at ambient temperature, and (3) 1 mg/L standard at a different temperature (usually lower) than ambient. For best results, insure a temperature difference of at least 10 C°.

NITRATE

When selecting number **7 – ISE4-NO3**, you will be given the choice of 1-point, 2-point, or 3-point calibrations for your nitrate (NO_3^-) sensor. The procedure is identical to that for the ammonium sensor, except that the calibrant values are in mg/L of NO_3-N instead of NH_4-N.

CHLORIDE

When selecting number **8 – ISE5-CL-**, you will be given the choice of 1-point, 2-point, or 3-point calibrations for your chloride (Cl^-) sensor. The procedure is identical to that for the ammonium sensor, except that the calibrant values are in mg/L of Cl instead of NH_4-N. IMPORTANT: We recommend that the user employ standards for chloride that are 10 times greater than for ammonium and nitrate. Thus, the low calibration value should be 10 mg/L and the high calibration value should be 1000 mg/L Cl-. The difference is due to the fact that the effect of contamination of standards from inadvertent leakage of chloride ion from either the DO probe or the reference junction of the pH probe will be less significant at higher concentrations.

OPTIC TURBIDITY

When selecting number **9 – Turbidity,** there will be a choice of 1-point, 2-point, or 3-point calibrations for your turbidity sensor.

The **1-point** option is normally used to zero the turbidity probe in 0 NTU standard. Place the sonde in clear water with no suspended solids, and input 0 NTU at the screen prompt. Press **Enter** and the screen will display real-time readings that will allow you to determine when the turbidity readings have stabilized. Press **Enter** after the readings have stabilized to confirm the calibration and zero the sensor. Then, as instructed, press any key to return to the Calibrate menu. The 1-point option can also be used to adjust the turbidity system offset to any other turbidity value within the 0-1000 NTU range of the sensor while maintaining the slope(s) of previous 2- or 3-point calibration routines. For example, if desired, the sensor could be placed in 20 NTU standard, this value (rather than zero) Entered at the screen prompt, and the calibration confirmed to adjust the offset. The key to remember with regard to the 1-point calibration is that this procedure should only be used to update a previous 2-point or 3-point calibration.

Select the **2-point** option to calibrate the turbidity probe using only two calibration standards. In this case, one of the standards must be clear water (0 NTU) and the other should be in the range of known turbidity for the water to be monitored. For example, if the water to be evaluated is known to be low in turbidity, an appropriate choice of standards might be 0 and 10 NTU. However, for general purpose measurements an appropriate choice of standards is usually 0 and 100 NTU.

To begin the calibration, immerse the sonde in the 0 NTU standard, as instructed, and press **Enter.** It is mandatory that the 0 NTU standard be calibrated first. The screen will display real-time readings that will allow you to determine when the readings have stabilized. Pressing **Enter** will confirm the first calibration. Following the instructions on the screen, place the sonde in the second turbidity standard, input the correct turbidity value in NTU, press **Enter**, and view the stabilization of the values on the screen in real-time. After the readings have stabilized, press **Enter** to confirm the calibration. Then, as instructed, press any key to return to the Calibrate menu.

Select the **3-point** option for maximum accuracy over the entire range of 0 to 1000 NTU. As for the 2-point procedure, one of the standards must be 0 NTU. Because of the linearity characteristics of the sensors, we recommend that the other two standards have turbidity values of 10 and 100 NTU. However, the user can select any values that are deemed appropriate. The procedure for this calibration is the same as for a 2-point calibration, but the software will prompt you to place the sonde in the additional solution to complete the 3-point procedure.

For all turbidity calibration procedures, be certain that the standard and sensor are thermally equilibrated prior to proceeding with the calibration.

For further information related to setting up, calibrating and running turbidity measurements, refer to **Appendix E, Turbidity Measurements**.

OPTIC CHLOROPHYLL

When selecting number **Optic Chlorophyll,** there will be a choice of zeroing the full scale range of the fluorescence sensor (**Fluor Zero**), or calibrating with actual chlorophyll standards (**µg/L 1-point, 2-point, or 3-point**).

If you have selected **Fluor %FS** as a parameter in Report Setup, the sonde will report only relative values of fluorescence in the sample being measured. These values could then be

converted into actual chlorophyll concentrations in µg/L by using a post-calibration procedure, after the chlorophyll content of grab-samples taken during a sampling or monitoring study has been analyzed in a laboratory. This determination can involve conducting the extractive analysis procedure described for chlorophyll in *Methods for the Examination of Water and Wastewater* or by carrying out an *in situ* measurement of chlorophyll using a commercial benchtop fluorometer.

The **Fluor zero** option is used to zero the fluorescence probe in a medium that is chlorophyll-free. Place the sonde in clear water, and input 0 at the screen prompt. Press **Enter** and the screen will display real-time readings that will allow you to determine when the fluorescence readings have stabilized. Press **Enter** after the readings have stabilized to confirm the calibration and zero the sensor. Then, press any key to return to the Calibrate menu.

If you select **Chl µg/L** in the initial calibration routine, there will be a choice of 1-point, 2-point, or 3-point options. The 1-point selection is normally used to zero the fluorescence probe in a medium that is chlorophyll-free. If you use this method, you will either choose to utilize the default sensitivity for chlorophyll in the sonde software or to update a previous multipoint calibration. Usually you will place the sonde in clear water, and input 0 µg/L at the screen prompt. After pressing **Enter** the screen will display real-time readings allowing you to determine when the chlorophyll readings have stabilized. Press **Enter** after the readings have stabilized to confirm the calibration and zero the sensor. Then, as instructed, press any key to return to the Calibrate menu.

The 1-point option can also be used to adjust the chlorophyll system offset to any other chlorophyll value within the 0-200 µg/L range of the sensor while maintaining the slope(s) of previous 2- or 3-point calibration routines. For example, the sensor could be placed in 20 µg/L standard and this value (rather than zero) entered at the screen prompt, and the calibration confirmed to adjust the offset. The 1-point calibration procedure should only be used to update a previous 2-point or 3-point calibration or to accept the limitations of the default sensitivity.

Note: For the 2-point and 3-point calibrations described below, standards of known fluorescence are required. Two general types of standards can be used: (a) phytoplankton suspensions of known chlorophyll content, and (b) dye solutions whose fluorescence can be correlated to that of chlorophyll. The user is responsible for determining the chlorophyll content of phytoplankton suspensions, either by employing the extractive analysis procedure described in *Standard Methods for the Examination of Water and Wastewater*, or by analyzing the suspension *in situ* using a laboratory fluorometer. See Section 5, **Principles of Operation** and **Appendix I, Chlorophyll** of this manual for more information about chlorophyll standards.

Select the **2-point** option to calibrate the chlorophyll probe using only two calibration standards. In this case, one of the standards must be clear water (0 µg/L) and the other should be in the range of a known chlorophyll content of the water to be monitored. For example, if the water to be evaluated is known to be low in chlorophyll, an appropriate choice of standards might be 0 and 10 µg/L. However, for general-purpose measurements an appropriate choice of standards is usually 0 approximately 150 µg/L.

To begin the calibration, immerse the sonde in the 0 µg/L standard, as instructed, and press **Enter.** It is mandatory that the 0 µg/L standard be calibrated first. The screen will display real-time readings that will allow you to determine when the readings have stabilized. Pressing

Enter will confirm the first calibration. Following the instructions on the screen, place the sonde in the second chlorophyll standard, input the correct value in µg/L, press **Enter**, and view the stabilization of the values on the screen in real-time. After the readings have stabilized, press **Enter** to confirm the calibration. Then, as instructed, press any key to return to the Calibrate menu.

Select the **3-point** option for maximum accuracy over the entire range of 0 to 400 µg/L. As with the 2-point procedure, one of the standards must be 0 µg/L. The user can select any values for the second and third standards that are deemed appropriate. The procedure for this calibration is the same as for a 2-point calibration, but the software will prompt you to place the sonde in the additional solution to complete the 3-point procedure.

For all chlorophyll calibration procedures, be certain that the standard and sensor are thermally equilibrated prior to proceeding with the calibration

For further information related to calibrating your chlorophyll sensor, refer to Section 5, **Principles of Operation** and **Appendix I, Chlorophyll** of this manual.

2.9.3 FILE

Selections from the File menu allow the user to access data that has been stored in the sonde flash disk memory. Select number **3-File** from the Main menu.

```
------------------File-----------------
1-Directory     4-View file
2-Upload        5-Quick view file
3-Quick Upload  6-Delete all files


Select option (0 for previous menu): 1
```

- Select number **1-Directory** to view all files currently stored in sonde flash disk memory. The screen below shows 5 files that suggest the sonde was used to spot check two bridge locations, deployed for a week in the lake (sampling every 15 minutes), then used to recheck the bridge locations.

- Select number **2 - Upload** to view file lists in memory (same as shown above) and then upload the data to a PC or to the YSI 610 Display/Logger. The uploaded data can then be processed with YSI EcoWatch for Windows to allow data manipulation and to easily generate reports, plots, and statistics. Three formats for file transfer are available: PC6000, Comma & Quote Delimited, and ASCII text.

```
  File     Samples  First sample       Last sample        Interval  Site
1-BRIDGE1       20  07/10/96 09:42:52  07/10/96 09:44:12  Discrete  KentonRd.
2-BRIDGE2       20  07/10/96 10:15:20  07/10/96 10:16:40  Discrete  Lakeview
3-UPLAKE-A     672  07/17/96 12:00:00  07/31/96 12:00:00  00:15:00  LakeSiteA
4-BRIDGE11      21  07/31/96 12:31:00  07/31/96 12:32:22  Discrete  KentonRd.
5-BRIDGE22      21  07/31/96 12:42:31  07/31/96 12:43:54  Discrete  Lakeview

Select option (0 for previous menu):
```

PC6000 format will transfer the data so that it will be compatible with either EcoWatch (supplied with your sonde) or PC6000 (ordered separately) software packages. YSI recommends data transfer in this format since it is significantly more rapid than other transfer options. If this data is required in Comma & Quote Delimited and/or ASCII formats, the user can quickly generate data in these formats using the Export function in EcoWatch for Windows.

Comma & Quote Delimited format is commonly used to generate files that can be imported into spreadsheet software in your PC, where you can perform custom data analysis. A comma is still the delimiter, but the radix is corrected to a period. In most cases you should set the Page Length to 0 before using this type of upload format. See the Windows Help section in EcoWatch for information on setting the page length.

ASCII Text is another alternative to transferring data directly to your computer into spreadsheet or other PC-based software.

Prior to upload, a “Time window” display appears to allow you the option to select portions of the logged data to upload. You may select **1-Proceed** to upload all data logged from the dates and times shown.

```
--------------Time window--------------
1-Proceed
2-Start date=07/17/96
3-Start time=12:00:00
4-Stop  date=07/31/96
5-Stop  time=12:00:00

Select option (0 for previous menu):
```

Select **1-Proceed.** Choose the appropriate file transfer protocol. A status box will appear in the lower right quadrant of the screen. Verification of a successful transfer is indicated when all of the requested data are transferred.

```
---------------File type---------------
1-PC6000
2-Comma & ' ' Delimited
3-ASCII Text

Select option (0 for previous menu):
```

Press **0** or **Esc** to return to the File menu.

- When you select the number **3 – Quick Upload** option the same operation as **2-Upload** is performed, except that only the most recent flash disk file is uploaded and it is uploaded in its entirety. You still must choose the transfer format from the three options provided.

- Select number **4 - View File** to examine the data in any file currently stored in sonde flash disk memory. You will first view the same screen as viewed in the Directory menu. From this menu choose the file of interest, then, using the Time window menu, choose the dates and/or times of interest. If you choose dates or times that are not within the designated start and stop times, no data will be displayed.

You may choose the entire file. Use the **Space Bar** to alternately stop and to resume scrolling. Use the **Esc** key to cancel the view.

- Select the number **5 – Quick View File** option to view the last page of data from the last data file in flash disk memory. This feature is particularly useful in quickly reviewing recently acquired data at field sites so that system performance can be assessed.

- Select the number **6 – Delete all files** to IRREVERSIBLY remove all files from the sonde flash disk memory. It is critical not to use this option until all relevant data from sonde memory has been transferred to your computer via one of the upload options. There is a verification screen that appears, so that pressing the number 6 key does not immediately delete all files at this point.

2.9.4 STATUS

Select number **4-Status** from the Sonde Main menu to obtain general information about the sonde and its setup.

```
-----------------Status---------------
1-Version:1.00
2-Date=07/22/96
3-Time=09:04:28
4-Bat volts: 9.0
5-Bat life 21.2 days
6-Free bytes:129792
7-Logging:Inactive

Select option (0 for previous menu):
```

- Number **1-Version** helps you identify the specific version of sonde software loaded in the sonde. This number is especially useful if you are calling YSI Customer Service. It may also be useful to you if you are comparing 2 or more sondes purchased at different times.

- Select **2-Date and 3-Time** to display current date and time. This is not a "live" display, but may be updated by pressing the 2 or 3 key again. This may be useful for viewing or setting real time. You may correct date or time from this submenu, by entering the corrected date or time as described in System setup. You cannot alter date format from this screen. And you must use the 24-hour clock time format. This interface functions identically to the System setup routine, yet provides convenience if you detect an error in the real time number entered.

- In options **4, 5, and 6**, you can view battery voltage, battery life, and available free memory in your sonde to help you evaluate whether the current setup is appropriate to complete an active logging or to begin a study in which you have defined your logging parameters. If you press key 4, 5 or 6 before you exit this screen, it may change, since this triggers the Status screen to update information. Note that no battery information will appear for the 600R, 600XL, and 6820 sondes.

- Number **7-Logging** provides one of two messages, active or inactive, indicating whether your sonde is in the unattended logging mode. This logging status indicator is not relevant to logging in the discrete mode, since there is no way to enter the Status screen without stopping discrete logging.

Press **0** or **Esc** to exit the Status screen and return to Main menu.

2.9.5 SYSTEM

Select number **5-System** from the Sonde Main menu to set the date and time, customize the sonde communication protocol, adjust how information appears on the screen, and enter an instrument identification number.

Select option (0 for previous menu):

```
--------------System setup-------------
1-Date & time
2-Comm setup
3-Page length=25
4-Instrument ID=NotSet
5-SDI-12 address=0
6-(*)English
7-( )Français
8-( )Deutsch
```

Select **Date & time.** Press 4 and 5 to activate the date and time functions. Pay particular attention to the date format that you have chosen when entering date. Use the 24-hour clock format for entering time. Option **4- ( ) 4 digit** year may be chosen to have the date appear with a two or four digit year.

```
-----------Date & time setup-----------
1-(*)m/d/y          4-( )4 digit year
2-( )d/m/y          5-Date=08/11/98
3-( )y/m/d          6-Time=11:12:30

Select option (0 for previous menu):
```

Press **0** or **Esc** to return the System Setup menu.

Select **Comm setup** From the System Setup menu.

```
---------------Comm setup-------------
1-(*)Auto baud      5-( )2400 baud
2-( )300 baud       6-( )4800 baud
3-( )600 baud       7-(*)9600 baud
4-( )1200 baud

Select option (0 for previous menu): 0
```

The default is 9600, but you may change it to match your host communication interface protocol by typing in the corresponding number, 1 through 7. An asterisk confirms the selection. Auto baud may be selected along with any of the choices. The Auto baud option allows the sonde to recognize and adjust to the received characters and we recommend that it is activated.

NOTE: If you change the baud rate, exit the sonde interaction and immediately change the baud rate in EcoWatch for Windows, Comm Settings. If you do not adjust the baud rate in the PC software, the sonde will not be able to communicate with the computer or any display/logger and your system will appear to be "locked-up."

Press **Esc** or **0** to return to the System Setup menu.

Select **Page length**, from the System Setup menu, to adjust the page length and press **Enter**. This will allow you to control how many lines of data are sent to your display before a new header is shown. The smaller the page number, the fewer the lines of data will be transmitted to your display between headers. However, if you set the page length to zero (0), only the initial header will be displayed. In many cases, a page length of zero is the preferred configuration if you choose to upload your data in an ASCII or CDF format. See **Section 2.9, Sonde Menu** for more details.

NOTE: The header itself takes 4 lines. Therefore, if the page length is set to 25, there will be 21 lines of data and one header. Any page length less than 5 will result in no header being transmitted.

Select **Instrument ID** from the System setup menu to record the instrument ID number (usually the instrument serial number), and press **Enter**. A prompt will appear which will allow you to type in the serial number of your sonde. This will make sure that any data that is collected is associated with a particular sonde.

Press **Esc** or **0** to return to the System setup menu.

Select SDI-12 address from the System Setup menu to change the value. Input a number between 0 and 9 and then press **Enter** to confirm the selection. The SDI-12 default address is zero (0). This feature is fully described in **Section 7, Communication** and only utilized if the unit is to operate in a SDI-12 communication protocol network.

Finally, select your language of choice for the sonde menus. Then press **Esc** or **0** again to return to the Main menu.

2.9.6 REPORT

The Report menu allows you to configure all reports displayed by the sonde software. You will be able to select which parameters and units of measure that are displayed during operation.

Select number **6-Report** from the sonde Main menu. The following menu, or a similar menu, will be displayed. The parameters listed depend on both the sensors available and enabled on your sonde. Therefore your screen may not be identical to that shown below.

Select **Report** from the Main sonde menu to setup the report section. The Report Setup menu will be displayed.

```
--------------Report setup-------------
1-(*)Date m/d/y     E-(*)Orp mV
2-(*)Time hh:mm:ss  F-(*)NH4+ N mg/L
3-(*)Temp C         G-( )NH4+ N mV
4-( )SpCond mS/cm   H-( )NH3 N mg/L
5-( )Cond           I-(*)NO3- N mg/L
6-( )Resist         J-( )NO3- N mV
7-( )TDS            K-( )Cl- mg/L
8-(*)Sal ppt        L-( )Cl- mV
9-(*)DOsat %        M-(*)Turbid NTU
A-(*)DO mg/L        N-( )Chl ug/L
B-( )DOchrg         O-( )Fluor %FS
C-(*)pH             P-( )Battery volts
D-( )pH mV

Select option (0 for previous menu):
```

The asterisks (*) that follow the numbers or letters indicate that the parameter will appear on all outputs and reports. To turn a parameter on or off type the number or letter, that corresponds to the parameter, after **Select option**.

For parameters with multiple unit options such as temperature, conductivity, specific conductance, resistivity and TDS, a submenu will appear as shown below, allowing selection of desired units for this parameter.

```
--------------Select units-------------
1-(*)NONE
2-( )Temp C
3-( )Temp F
4-( )Temp K

Select option (0 for previous menu): 2
```

After configuring your display with the desired parameters, press **Esc or 0** to return to the Main menu.

Even if all of the sensors are enabled, the measurements for those sensors will not appear on your display unless the parameter is selected in Report setup. In order for a specific parameter to show up on a report:

1. The sensor must first be enabled (turned on).
2. That parameter must be activated in the Report setup.

In the above example, if the appropriate sensors have been activated in the Sensor setup section, the following parameters will be displayed to the computer screen or captured to a computer or data collection platform when the sonde is sampling: Temperature in C, Salinity in parts per

thousand, Dissolved Oxygen in % air saturation, Dissolved Oxygen in mg/L, pH, ORP in millivolts, Ammonia-N, Nitrate-N, and Turbidity in NTUs. Date and time will also be displayed.

NOTE: Do not attempt to memorize or associate a number or letter with a particular parameter. The numbering scheme is dynamic and changes depending on the sensors which have been enabled.

The following list is a complete listing of the abbreviations utilized for the various parameters and units available in the Report setup menu.

Parameter	Description
Date	Day/Month/Year (format selectable)
Time	Hour:Minute:Second (24-hour clock format)
Temp C	Temperature in degrees Celsius
Temp F	Temperature in degrees Fahrenheit
Temp K	Temperature in degrees Kelvin
SpCond mS/cm	Specific Conductance in milliSiemens per centimeter
SpCond uS/cm	Specific Conductance in microSiemens per centimeter
Cond mS/cm	Conductivity in milliSiemens per centimeter
Cond uS/cm	Conductivity in microSiemens per centimeter
Resist MOhm*cm	Resistivity in MegaOhms * centimeter
Resist Kohm*cm	Resistivity in KiloOhms * centimeter
Resist Ohm*cm	Resistivity in Ohms * centimeter
TDS g/L	Total dissolved solids in grams per liter
TDS kg/L	Total dissolved solids in kilograms per liter
Sal ppt	Salinity in parts per thousand
DO sat %	Dissolved oxygen in % air saturation
DO mg/L	Dissolved oxygen in milligrams per liter
DO chrg	Dissolved oxygen sensor charge
Press psia	Pressure in pounds per square inch absolute
Press psir	Pressure in pounds per square inch relative
Depth meters	Water column in meters
Depth feet	Water column in feet
pH	pH in standard units
pH mV	millivolts associated with the pH reading
Parameter	Description
Orp mV	Oxidation reduction potential value in millivolts
NH4+ N mg/L	Ammonium Nitrogen in milligrams/liter
NH4+ N mV	Ammonium Nitrogen in millivolt reading
NH3 N mg/L	Ammonia Nitrogen in milligrams/liter
NO3- N mg/L	Nitrate Nitrogen in milligrams/liter
NO3- N mV	Nitrate Nitrogen in millivolt reading
Cl- mg/L	Chloride in milligrams/liter
Cl- mV	Chloride in millivolt reading
Turbid NTU	Turbidity in nephelometric turbidity units
Chl ug/L	Chlorophyll in micrograms/liter
Fluor %FS	Fluoresence in percent Full Scale

2.9.7 SENSOR

The Sensor menu allows you to Enable or Disable (turn on or off) any available sensor and, in some cases, to select the port in which your sensor is installed.

From the Sonde Main menu select number **7-Sensor** and the following display will appear.

```
------------Sensors enabled------------
1-(*)Time
2-(*)Temperature
3-(*)Conductivity
4-(*)Dissolved Oxy
5-(*)ISE1 pH
6-(*)ISE2 Orp
7-(*)ISE3 NH4+
8-(*)ISE4 NO3-
9-( )ISE5 NONE
A-(*)Optic Turbidity

Select option (0 for previous menu):
```

Note that the exact appearance of this menu will vary depending upon the sensors available on your sonde.

When a particular sensor is active, an asterisk will appear in the parentheses associated with the selection. In this example the time, temperature, conductivity, dissolved oxygen, pH, ORP, ammonium, nitrate, turbidity and battery sensors are enabled. To disable a sensor, simply press the number of the active sensor or port, and the asterisk will disappear.

For ISE2 to ISE5 press the appropriate number, and then enable or disable the sensor using the submenu choices. Be certain that the appropriate sensor is “enabled” in the submenu according to the sonde bulkhead port in which it is physically installed. For example, if an ammonium sensor is placed in the port labeled “3” on the bulkhead, enable the sensor as ISE3 in the menu structure.

The following screen is the submenu selection structure for ISE3, ISE4 and ISE5.

```
--------------Select type-------------
1-( )ISE3 NH4+      3-( )ISE3 Cl-
2-( )ISE3 NO3-

Select option (0 for previous menu):
```

For ISE2, the submenu selection structure will appear.

```
--------------Select type-------------
1-( )ISE2 Orp       3-( )ISE2 NO3-
2-( )ISE2 NH4+      4-( )ISE2 Cl-

Select option (0 for previous menu): 0
```

The probe corresponding to ISE2 is inserted in the bulkhead port characterized by the 4-pin Lemo connector. This port is different in appearance from the ISE3, ISE4, and ISE5 ports that are numbered on the bulkhead and use leaf-spring connectors. With the present configuration of the sonde and software, only an ORP probe can be assigned to ISE2 and thus either no selection or a selection of "1" must be made in the ISE2 submenu. Ammonium, nitrate and chloride sensors cannot be installed in the port corresponding to ISE2.

Optic Turbidity and Optic Chlorophyll also appear on a submenu similar to ISEs.

2.9.8 ADVANCED

From the Sonde Main menu select number **8-Advanced** to display the sensor calibration constants, additional setup options, sensor coefficients and constants, and digital filtering options. The parameters listed depend on both the sensors installed and the sensors enabled, therefore your screen may not be identical to those shown below.

```
----------------Advanced-------------
1-Cal constants
2-Setup
3-Sensor
4-Data filter

Select option (0 for previous menu): 1
```

Select number **1-Cal constants** to display the calibration constants, as shown in the following example. Note that values only appear for the enabled sensors.
The following table provides the default value, operating range, and comments relative to the calibration constants. Error messages will appear during calibration if values are outside the indicated operating range unless the designation is "not checked".

```
-------------Cal constants-------------
1-Cond:5              B-NO3 A:2.543
2-DO gain:1.3048      C-Cl J:99.5
3-mV offset:0         D-Cl S:-0.195
4-pH offset:0         E-Cl A:2.543
5-pH gain:-5.05833    F-Turb Offset:0
6-NH4 J:51.2          G-Turb A1:500
7-NH4 S:0.195         H-Turb M1:500
8-NH4 A:1.092         I-Turb A2:1000
9-NO3 J:99.5          J-Turb M2:1000
A-NO3 S:-0.195

Select option (0 for previous menu): 0
```

Default	***Operating range***	***Comments***	
Cond:	5	2.5 to 10.0	(traditional cond constant)
DO gain:	1	0.5 to 2.0	(relative to default)
Pres offset:			
if not vented	-14.7	-20.7 to -8.7	
if vented	0.0	-6 to 6	
mV offset:	0.0	-100 to 100	
pH offset:	0.0	-400 to 400	
pH gain:	-5.0583	-6.07 to -4.22	
NH4 J	51.2	Not checked	
NH4 S	0.195	0.15 to 0.217	
NH4 A	1.092	Not checked	
NO3 J	99.5	Not checked	
NO3 S	-0.195	-0.217 to -0.15	
NO3 A	2.543	Not checked	
Cl J	99.5	Not checked	
Cl S	-0.195	-0.217 to -0.15	
Cl A	2.543	Not checked	
Turb Offset	0	-10 to 10	
Turb A1	500	0.6 to 1.5	Range is ratio of A1 to M1
Turb M1	500		
Turb A2	1000	0.6 to 1.5	Range is ratio of A2 to M2
Turb M2	1000		
Chl Offset	0	-10 to 10	
Chl A1	500		
Chl M1	500		
Chl A2	1000		
Chl M2	1000		

To reset a calibration cell constant, access the sonde Calibrate menu. Then select the sensor and type “UNCAL” instead of the value. This action will change that sensors calibration constants back to the factory default.

From the Advanced menu, select **2-Setup** to display miscellaneous options. Type the appropriate number to activate/deactivate any of the displayed features.

```
-------------Advanced setup-----------
1-(*)VT100 emulation
2-( )Power up to Menu
3-( )Power up to Run
4-( )Comma radix
5-(*)Auto sleep RS232
6-( )Auto sleep SDI12
7-( )Multi SDI12
8-( )Full SDI12

Select option (0 for previous menu): 0
```

1-(*)VT100 emulation. Activate this option for VT100 terminal emulation. This feature allows the sonde to send escape sequences to clear the screen which in turn results in an improved display. Usually this feature should be activated, but, if your terminal or terminal emulator shows odd characters at the beginning of each menu title, then turn this item off. With the feature off, the sonde will send several carriage returns and line feeds to 'clear' the display. The number of <cr>'s and <lf>'s is determined by the page length setting.

2-(*)Power up to Menu. When this item is enabled, the sonde will go directly to menu mode when power is applied to the sonde. If the command line mode is not useful for your applications, then enabling this item will negate the need to type “Menu” and **Enter** at the # prompt to access the Main sonde menu.

3-(*)Power up to Run. When this item is enabled the sonde will start sampling and output data as soon as power is applied to the sonde. If “Power up to menu” is also enabled, the sonde will first enter the menu mode and then the run mode where it will start sampling. If “Power up to menu” is not enabled, the sonde will go to command line mode and then start the run function. With “Power up to Run” disabled, the sonde will wait for your command at power up (in either command line or menu mode) as set by “Power up to Menu”. If you are using your sonde for Unattended sampling, do not activate this mode.

4-(*)Comma radix. When this item is enabled, the sonde will replace decimal points with commas when printing numbers. NOTE: Regardless of this setting, SDI-12 'D' commands will still respond using a decimal point.

5-(*)Auto sleep RS232. Activation of this feature enables a power savings system when communicating with the sonde in RS-232 mode. When enabled, power is only applied to the sensors during sampling or calibration. Additionally, if the sonde is not sampling or calibrating, it will “sleep” after one minute with no communications. Any character sent to it when sleeping will “wake” it, although the character sent will be discarded. It takes the sonde about 30 milliseconds to wake up. Disabling this item allows for “instant” readings. Generally, this

feature should be activated for long term monitoring studies in the RS-232 communication mode.

6-(*)Auto sleep SDI12. Activation of this feature enables the power savings system when communicating with the sonde in SDI-12 mode. This is basically the same as item 5 above except that it is used in communication via the SDI-12 interface. Also, the sonde will "sleep" in about 100 milliseconds in the absence of communication, rather that waiting one minute in the Auto sleep RS-232 mode.

7-(*) Multi SDI12. Modifies the SDI12 protocol as follows: (1) No SDI12 service request will be issued. (2) Break commands will not cause a measurement reading to be aborted. Normally, you should leave this feature "off".

8-(*) Full SDI12. Enabling this feature forces full SDI-12 specification in order to pass the NR Systems SDI-12 Verifier. Disabling this feature will allow the unit to be more fault tolerant and will save some power. We recommend that you leave this feature "off".

Select number **3-Sensor** to display and change user-configurable constants as shown in the following display. Type the appropriate number to change to these parameters.

```
-----------Advanced sensor----------
1-TDS constant=0.65
2-Latitude=40
3-Altitude Ft=0
4-(*)Fixed probe
5-( )Moving probe
6-DO temp co %/C=1.1
7-DO warm up sec=40
8-(*)Wait for DO
9-Wipes=1
A-Wipe int=1
B-SDI12-M/wipe=1
C-Turb temp co %/C=0.3
D-(*)Turb spike filter
E-Chl temp co %/C=0
F-(*)Chl spike filter

Select option (0 for previous menu):
```

NOTE: The number of items on this menu depends greatly on the sensors that are available and enabled on your sonde. Below we describe every possible item on this menu. Your sonde probably does not have every item described below.

To edit one of the following menu items choose the number or letter that corresponds to it.

TDS constant=0.65 This selection allows you to set the constant used to calculate TDS. TDS in g/L is calculated by multiplying this constant times the specific conductance in

mS/cm. This item will only appear if the conductivity sensor is enabled in the "Sensors enabled" menu.

Salinity=0 This selection allows you to input a manually-acquired value of salinity for calculating other parameters such as DO mg/L. *This item is not used or displayed if the conductivity sensor is enabled in the Sensors menu.*

Pres=0 psi This selection allows you to set a value of pressure for calculating other parameters like salinity. *This item is not used or displayed if the pressure sensor is enabled in the Sensors menu.*

Latitude=40 This selection allows you to input the global position (latitude) where the sonde is sampling. The units are degrees. For accuracy, enter the decimal equivalent to indicate degrees and minutes. For example, enter 41° 30 ' as 41.5. This value is used in the calculation of depth or level to account for global variations in the gravitational field. *This item will only appear if the pressure sensor is enabled in the Sensors menu.*

Flow Setup… This selection allows you to setup the sonde to output flow information. See **Appendix F, Flow** for detailed information on how to setup the Flow parameter. *This item will only appear if the sonde has shallow vented level.*

Altitude=0 This selection allows you to input the local altitude (relative to sea level) where the sonde is sampling. The units are feet. You may enter positive or negative values (range is -276 to 29028) to represent altitudes above or below sea level. This value is used in the calculation of depth or level. *This item will only appear if the pressure sensor is enabled in the Sensors menu.*

(*)Fixed probe This selection allows you to identify how your sonde is being used. If your sonde is "fixed" or secured to a dock, buoy, platform or similar, select this option. This information is used in the calculation of depth and level. *This item will only appear if the Pressure-Abs sensor is enabled in the Sensors menu.*

(*)Moving probe This selection allows you to identify how your sonde is being used. If your sonde is being used in depth profiling select this option. This information is used in the calculation of depth and level. *This item will only appear if the Pressure-Abs sensor is enabled in the Sensors menu.*

DO temp co=1.1%/C This selection allows you to input the dissolved oxygen temperature coefficient. Do not change this value unless you consult YSI Customer Service. *This item will only appear if the DO sensor is enabled in the Sensors menu.*

DO warm up=40 This selection allows you to set the amount of time allowed for DO warm up in seconds. Normally the default value of 40 seconds is adequate for most applications. However, there may be certain situations in which greater DO accuracy can be attained by increasing this time. Consult YSI Customer Service if you feel that your DO warm up time is incorrect. *This item will only appear if the DO sensor is enabled in the Sensors menu.*

(*)Wait for DO When this feature is enabled, the sonde is forced to wait for the DO warm up time to expire before displaying any readings. Note that in SDI12 mode or while calibrating the DO sensor, the warm up time is used regardless of the activation of this item. Disabling this item allows you to see data without having to wait during the DO warm up time. Under normal operating conditions, this item should be turned off. If you are using the sonde with a data logger in RS232 mode and will be turning the sonde "on" and "off" for each sample, then you may want to enable this item so that only stable DO data are recorded. *This item will only appear if the DO sensor is enabled in the Sensors menu.*

Wipes=1 If a turbidity or chlorophyll sensor is enabled, this selection will determine the number of cleaning cycles which will occur when the wiper is activated manually or automatically. Since the wiper functions bidirectionally, a selection of "1" results in two passes of the wiper over the optical face. In most applications, a single cleaning cycle is adequate to keep the optical surface free of bubbles and fouling. However, in particularly harsh environments additional cleaning cycles may be needed and can be selected here. *This item will only appear if a turbidity or chlorophyll sensor is enabled in the Sensors menu.*

Wipe Int=1 In applications where a mechanically-cleaned turbidity or chlorophyll probe is installed in the sonde and the instrument is collecting unattended data while attached to a data collection platform or computer, the wiper mechanism of the probe should be activated automatically in a periodic manner to clean the optical surface for fouling and bubbles. The value entered at this selection is the number of minutes between each automatic cleaning cycle. Thus, if Wipe Int is set to "5" and the instrument is in the Run mode, the wiper will activate every 5 minutes with no manual input. *This item will only appear if a turbidity or chlorophyll sensor is enabled in the Sensors menu.*

The value of Wipe Int is sometimes overridden when the instrument is set up in the Unattended sampling mode. Under these conditions, the wiper will be automatically activated at the interval assigned in the Unattended setup rather than that assigned in Wipe Int. Thus, in an Unattended study setup at a 15 minute sampling interval, the wiper will be activated only once every 15 minutes rather than at the indicated Wipe Int of 1 minute.

CAUTION: If Wipe Int is set to zero, then no wiping will occur either in Discrete or Unattended Sampling. Make certain that Wipe Int is set to some finite value prior to setting up an Unattended study or no automatic cleaning will occur.

SDI12-M/Wipe=1 This is the number of wiping cycles when the sonde is in SDI12 mode. The wiper for the 6026 turbidity sensor or the 6025 Chlorophyll Sensor will automatically wipe each time this many SDI12 "M" commands have been issued. If this value is set to zero, then no automatic wiping will occur. *This item will only appear if a turbidity or chlorophyll sensor is enabled in the Sensors menu.*

Turb temp co %/C=0.3 This entry sets the coefficient for the temperature compensation of turbidity readings from the 6036 and 6026 sensors. The default value of 0.3 should not be changed by the user without consulting YSI Customer Service. *This item will only appear if a turbidity sensor is enabled in the Sensors menu.*

(*) Turb Spike Filter When this item is activated, the output of the turbidity sensor is mathematically processed to minimize the effect of unusual (or "bad") readings on the overall data presentation. In most cases, these "spike" events are the result of the chance passage of large suspended particles across the probe optics just at the time a reading is taken. Activation of this option generally results in a better display of the "average" turbidity of the water under examination and its use is recommended for most sampling and unattended applications. *This item will only appear if a turbidity sensor is enabled in the Sensors menu.*

Chl temp co %/C=0.0 This entry sets the coefficient for the temperature compensation of chlorophyll readings from the 6025 sensor. The default value of zero should only be changed by the user after establishing the temperature compensation factor for the phytoplankton sample in question. See Section 5.12, Chlorophyll and **Appendix I, Chlorophyll** of this manual for more information. *This item will only appear if a chlorophyll sensor is enabled in the Sensors menu.*

( ) Chl Spike Filter When this item is activated, the output of the chlorophyll sensor is mathematically processed to minimize the effect of unusual (or "bad") readings on the overall data presentation. Normally, activation of the item is not required. *This item will only appear if a chlorophyll sensor is enabled in the Sensors menu.*

From the Advanced menu, select **4-Data filter** to display filtering options. Type the appropriate number to activate/deactivate any of the displayed features.

Sondes with **neither turbidity or chlorophyll probes** enabled will display the following menu.

```
------------Data filter setup----------
1-(*)Enabled
2-( )Wait for filter
3-Time constant=4
4-Threshold=0.001

Select option (0 for previous menu):
```

If either **turbidity or chlorophyll is enabled** then the menu will appear as follows.

```
------------Data filter setup----------
1-(*)Enabled
2-( )Wait for filter
3-Time constant. . .
4-Threshold. . .

Select option (0 for previous menu):
```

Choosing 3 for Time Constant will display something similar to the following:

```
------------Time constant ----------
1- Turbid=12
2- Chl=12
3- Other=4


Select option (0 for previous menu):
```

These are the recommended settings for the time constants. Note that the time constant can be set independently for turbidity and chlorophyll. All other sensors use the same time constant. Setting thresholds is done in the same manner. Recommended threshold settings are 0.01 for turbidity, 1.0 for chlorophyll, and 0.001 for other.

1-(*) Enabled. Activating this item will result in data filtering according to the values set in (2), (3), and (4).

2-(*) Wait for filter. If this feature is activated, readings will be available for output only after the unit has warmed up for a time period equal to the Time Constant plus an extra 4 seconds. This feature is useful, for example, if you are operating in SDI12 mode and want to average the data over a particular period of time. In such a case, you would not want the filter to be engaging and disengaging, so the value of the Threshold should be set to a large value like 1. This feature should not be activated for normal use of the sonde.

3-Time Constant. This value is the time constant in seconds for the software data filter. Increasing the time constant will result in greater filtering of the data, but will also slow down the apparent response of the sensors.

4-Threshold. This value determines when the software data filter will engage/disengage. When the difference between two consecutive unfiltered readings is larger than the threshold, then the reading is displayed unfiltered. When the difference between two consecutive readings drops below the threshold, readings will be filtered again. For the purposes of the filter, consecutive readings are never more than 0.5 seconds apart. When sampling faster than 0.5 seconds consecutive readings will be at the faster rate and you may want to adjust the threshold accordingly. See section 2.9.1 for details on fast sampling.

The threshold feature is intended to speed response to large changes in a reading. For example, when changing from pH 7 buffer to a pH 4 buffer in a calibration, it is likely that the filter will disengage for a time showing unfiltered readings until the sensor has nearly equilibrated with the new buffer. At that time, the filter will re-engage and show filtered readings. Without disengaging the filter for awhile, much more time would be required to come to equilibrium after large changes in reading.

During the first time constant after the filter first engages, the output reflects a simple average of all the readings from the time the filter engaged until the present. Once the filter has been engaged for the period of the time constant, it becomes a simple filter with a time constant equal to that set in **3-Time Constant**. Each time the filter disengages and then re-engages, this process is repeated.

Filter engagement and disengagement occurs for each sensor independently. One parameter may be filtered while another is not because readings from one sensor are changing more than another.

Example: Moving a sonde from the air to a river water sample. Assume that the temperature of the sonde is similar to the temperature of the water, and that the water is in equilibrium with the air. The temperature and oxygen readings taken in the water will be very similar to those taken in the air. The conductivity reading in air is near zero, and quite likely, is a very different reading in the water. The filter for the conductivity readings will likely disengage when the sonde is first placed in the river water, but stay engaged for the temperature and dissolved oxygen readings.

The filters for turbidity and chlorophyll are somewhat different. For these sensors, the filter is temporarily disengaged during mechanical wiping so that when wiping is finished, the reading is the most current. The filter then reengages if possible. Turbidity and chlorophyll readings are frozen to the output during wiping so that “bad” values are not output.

A value of 0.001 for the threshold roughly corresponds to the following changes in sensor readings:

Temp: 0.1 °C
Conductivity in the 100 mS/cm range: 0.1 ms/cm
Conductivity in the 10 mS/cm range: 0.01 ms/cm
Conductivity in the 1 mS/cm range: 0.001 ms/cm
Conductivity in the 100 µS/cm range: 0.1 us/cm
Dissolved Oxygen: 0.2 percent air saturation
pH, ORP, Ammonium, Nitrate and Chloride: 0.6 mV

A value of 0.01 for the threshold roughly corresponds to a 10NTU change in turbidity. A value of 1.0 for the chlorophyll sensor threshold effectively means that the filter will be engaged under all conditions.

2.10 CARE, MAINTENANCE AND STORAGE

This section describes the proper procedure for storage of the sensors that will maximize their lifetime and minimize the time required to get the sonde ready for a new application. This section will describe interim or short-term storage between applications where the sonde is being used at a regular interval (daily, weekly, biweekly, etc.). and long term storage, (e.g., over-the-winter), where the sonde will not be used on a regular basis for several months.

In the descriptions and instructions below, it is assumed that the user has retained the vessels (bottles, boots, etc.) in which the individual sensors were stored on initial delivery. If these specific items have been misplaced or lost, they can be replaced by contacting YSI Customer Service. Alternatively, the user may have similar (and equally acceptable) storage equipment on hand even though it was not part of the original YSI package. Common sense should be the guide on substitution of storage vessels.

REMEMBER: DO NOT ATTEMPT TO GAIN ACCESS TO THE INTERNAL CIRCUITRY OF THE SONDE.

2.10.1 SONDE CARE AND MAINTENANCE

The YSI 6570 Maintenance Kit is available for use with your sonde. The kit includes several items that will be helpful or necessary to perform the proper routine maintenance on your sonde.

The 6570 Maintenance Kit includes two types of O-rings (for probes and cable connector), probe/installation/replacement tools, two cleaning brushes for the conductivity sensor, O-ring lubricant, and a syringe for cleaning the depth sensor port.

The 6570 Maintenance Kit can be ordered from any authorized YSI dealer, or directly from YSI. See Appendix C for details.

When caring for your sonde, remember that the sonde is sealed at the factory, and there is never a need to gain access to the interior circuitry of the sonde. In fact if you attempt to disassemble the sonde, you would void the manufacturer's warranty.

SONDE PROBE PORTS

Whenever you install, remove or replace a probe, it is extremely important that the entire sonde and all probes be thoroughly dried prior to the removal of a probe or a probe port plug. This will prevent water from entering the port. Once you remove a probe or plug, examine the connector inside the sonde probe port. If any moisture is present, use compressed air to completely dry the connector. If the connector is corroded, return the sonde to your dealer or directly to YSI Customer Service, see **Section 8, Warranty and Service Information**, for details. When you reinstall a probe or port plug, lightly grease the O-ring with lubricant supplied in the YSI 6570 Maintenance Kit.

CABLE CONNECTOR PORT

The cable connector port at the top of the sonde should be covered at all times. While communicating with the sonde, a cable should be installed and tightened in place. This will assure that a proper connection is being made and prevent moisture and contaminants from entering.

When a communications cable is not connected to the cable connector port, the pressure cap supplied with the instrument should be securely tightened in place.

If moisture has entered the connector, dry the connector completely using compressed air, a clean cloth, or paper towel. Apply a very thin coat of lubricant from the 6570 Maintenance Kit to the O-ring inside the connector cap before each installation.

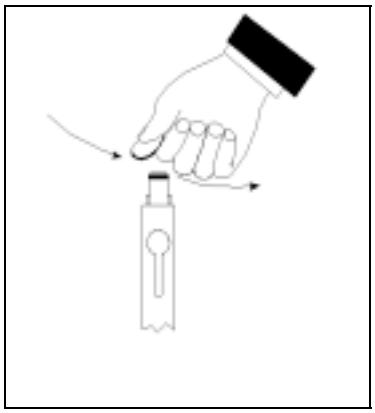
2.10.2 PROBE CARE AND MAINTENANCE

Once the probes have been properly installed, remember that periodic cleaning and DO membrane changes are required.

6562 DO PROBES

For best results, we recommend that the KCl solution and the Teflon membrane at the tip of the 6562 probe be changed prior to each sonde deployment and at least once every 30 days during the use of the sonde in sampling studies. In addition, the KCl solution and membrane should be changed if (a) bubbles are visible under the membrane; (b) significant deposits of dried electrolyte are visible on the membrane or the O-ring; and (c) if the probe shows unstable readings or other probe-related symptoms. See Section 2.3 for instructions on changing the DO membrane.

After removing the used membrane from the tip of the 6562 probe, examine the electrodes at the tip of the probe. If either or both of the silver electrodes are black in color, the probe should be resurfaced using the fine sanding disks which are provided in the 6035 reconditioning kit.



To resurface the probe using the fine sanding disk, follow the instructions below.

First dry the probe tip completely with lens cleaning tissue. Next, hold the probe in a vertical position, place one of the sanding disks under your thumb, and stroke the probe face in a direction parallel to the gold electrode (located between the two silver electrodes). The motion is similar to that used in striking a match. Usually 10-15 strokes of the sanding disk are sufficient to remove black deposits on the silver electrodes. However, in extreme cases, more sanding may be required to regenerate the original silver surface.

After completing the sanding procedure, repeatedly rinse the probe face with clean water and wipe with lens cleaning tissue to remove any grit left by the sanding disk. After cleaning, thoroughly rinse the entire tip of the probe with distilled or deionized water and install a new membrane.

IMPORTANT: Be sure to: (1) Use *only* the fine sanding disks provided in the 6035 maintenance kit in the resurfacing operation and (2) Sand in a direction parallel to the gold electrode. *Not adhering to either of these instructions can seriously damage the electrodes.*

NOTE: If this procedure is unsuccessful, as indicated by improper probe performance, it may be necessary to return the probe to an authorized service center. See **Section 8, Warranty and Service Information**, for contact information.

6560 CONDUCTIVITY/TEMPERATURE PROBES

The openings that allow fluid access to the conductivity electrodes must also be cleaned regularly. The small cleaning brush included in the 6570 Maintenance Kit is ideal for this purpose. Dip the brush in clean water and insert it into each hole 15-20 times. In the event that deposits have formed on the electrodes, it may be necessary to use a mild detergent with the brush. After cleaning, check the response and accuracy of the conductivity cell with a calibration standard.

NOTE: If this procedure is unsuccessful, or if probe performance is impaired, it may be necessary to return the probe to an authorized dealer service center See **Section 8, Warranty and Service Information** for contact information.

The temperature portion of the probe requires no maintenance.

6561 pH AND 6565 COMBINATION pH-ORP PROBES

Cleaning is required whenever deposits or contaminants appear on the glass and/or platinum surfaces of these probes or when the response of the probe becomes slow.

Remove the probe from the sonde. Initially, simply use clean water and a soft clean cloth, lens cleaning tissue, or cotton swab to remove all foreign material from the glass bulb (6561 and 6565) and platinum button (6561). Then use a moistened cotton swab to carefully remove any material that may be blocking the reference electrode junction of the sensor.

CAUTION: When using a cotton swab with the 6561 or 6565, be careful NOT to wedge the swab tip between the guard and the glass sensor. If necessary, remove cotton from the swab tip, so that the cotton can reach all parts of the sensor tip without stress.

If good pH and/or ORP response is not restored by the above procedure, perform the following additional procedure:

1. Soak the probe for 10-15 minutes in clean water containing a few drops of commercial dishwashing liquid.

2. GENTLY clean the glass bulb and platinum button by rubbing with a cotton swab soaked in the cleaning solution.

3. Rinse the probe in clean water, wipe with a cotton swab saturated with clean water, and then rerinse with clean water.

If good pH and/or ORP response is still not restored by the above procedure, perform the following additional procedure:

1. Soak the probe for 30-60 minutes in one molar (1 M) hydrochloric acid (HCl). This reagent can be purchased from most distributors. Be sure to follow the safety instructions included with the acid.

2. GENTLY clean the glass bulb and platinum button by rubbing with a cotton swab soaked in the acid.

3. Rinse the probe in clean water, wipe with a cotton swab saturated with clean water, and then rerinse with clean water. To be certain that all traces of the acid are removed from the probe crevices, soak the probe in clean water for about an hour with occasional stirring.

If biological contamination of the reference junction is suspected or if good response is not restored by the above procedures, perform the following additional cleaning step:

1. Soak the probe for approximately 1 hour in a 1 to 1 dilution of commercially-available chlorine bleach.

2. Rinse the probe with clean water and then soak for at least 1 hour in clean water with occasional stirring to remove residual bleach from the junction. (If possible, soak the probe for period of time longer than 1 hour in order to be certain that all traces of chlorine bleach are removed.) Then rerinse the probe with clean water and retest.

Dry the sonde port and probe connector with compressed air and apply a very thin coat of O-ring lubricant to all O-rings before re-installation.

DEPTH SENSOR

The depth sensor modules are factory installed options that are located between the bulkhead and the sonde tube. For 600XL and 600XLM sondes, there is a circular protective cap with two small holes. The cap cannot be removed, but a syringe is supplied in the maintenance kit to aid in cleaning the pressure port. Fill the syringe with clean water, place the tip of the syringe into one of the holes and gently force water through the pressure port. Ensure that the water comes out of the other hole. Continue flushing the pressure port until the water comes out clean.

***CAUTION*:** Never try to remove the circular pressure port cap.

For 6920, 6600 and 6820 sondes, the depth sensor is exposed to the water by either a circular access port on the side of the sonde or a though-hole on a module just above the sonde bulkhead. A syringe is supplied in the maintenance kit to aid cleaning the pressure port. Fill the syringe with clean water, place the tip of the syringe into one of the holes and gently force water through

the access port. Ensure that the water comes out of the other hole. Continue flushing the pressure port until the water comes out clean.

***CAUTION*:** Do not attempt to remove the depth module from the sonde body.

LEVEL SENSOR

For level sensors follow all the maintenance procedures given for depth sensors. In addition, ensure that the desiccant always remains active. Active desiccant is a distinctive blue color. When it can absorb no more moisture, it is a rose red or pink color. For either the cartridge or the canister, the end that is vented to atmosphere will begin to change color first. As long as the desiccant closest to the sonde is blue, no maintenance is required. Local conditions will dictate how long the desiccant will last. In humid environments, the desiccant may need to be changed or regenerated well before it is completely exhausted to ensure that it lasts the entire deployment.

You may regenerate the desiccant, replace the desiccant in the cartridge or canister, or replace the entire cartridge or canister. See **Appendix G, Using Vented Level**, for more information.

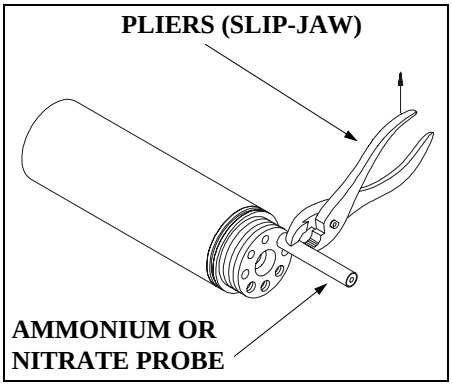
To regenerate the desiccant, remove it from the unit and spread it evenly, one granule deep, on a suitable tray. Heat for about one hour at about 200° C (about 400° F). The desiccant should then be cooled in a suitable, tight container before refilling the unit. The color of the desiccant will return to blue if the regeneration cycle has been successful. The felt filters should also be dried at about 100° C (about 200° F) for about 30 minutes before assembly.

Desiccant material is sold separately. Both the cartridge and canister can easily be opened, emptied, and refilled.

***CAUTION*:** It is important to keep the tube in vented sondes and cables dry. They are supplied with caps for closing the volume when not in use. Keep the caps on until just before calibration and deployment. For storage, replace the caps.

6882 CHLORIDE, 6883 NITRATE AND 6884 AMMONIUM SENSORS

You should clean these probes whenever deposits or contaminants appear on the ion selective membranes located on the tips of these sensor modules. If possible, the module should be cleaned while installed in the sonde bulkhead. Use clean water and a moist piece of lens cleaning tissue to *gently* wipe the sensor membranes until no more contaminants are removed. However, under some conditions, it may be necessary to remove the module from the sonde bulkhead for cleaning and/or storage. To remove the module, follow the diagram at the side. Remove the module with finger pressure only, if possible. However, it is acceptable to use small pliers if necessary to loosen the module for final removal by hand. **Be very careful not to squeeze the module any more than is necessary for a firm grip. Use slipjaw pliers to minimize the chance of applying too much pressure on the**

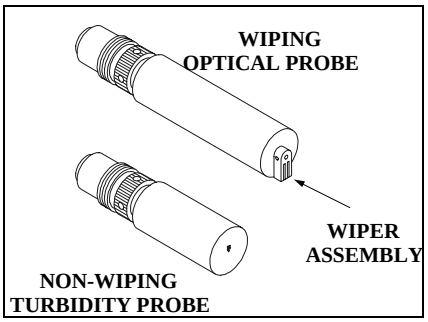


module. While the module is removed from the sonde, be sure to dry the sonde port and probe connector with compressed air and apply a very thin coat of lubricant to the O-ring before re-installation.

NOTE: The ion selective membranes are fragile. Be certain to: (1) Use only *moist*, high quality lens cleaning tissue for the cleaning procedure (not paper towels or other coarse materials); and (2) Stroke the probe face very gently with the tissue during the procedure. *If you do not adhere to these instructions, you can seriously damage the sensors.*

6025, 6026 AND 6036 CHLOROPHYLL AND TURBIDITY PROBES

The 6025, 6026 and 6036 probes require only minimal maintenance. After each deployment, the optical surface on the tip of the turbidity probe should be inspected for fouling and cleaned if necessary by gently wiping the probe face with moist lens cleaning paper. In addition, for the 6025 and 6026 probes, we recommended replacing the wiper periodically. The frequency of this replacement depends on the quality of water under examination. A replacement wiper is supplied with the probes, along with the small hex driver required for its removal and reinstallation. Follow the instructions supplied with the probe to ensure proper installation of the new wiper assembly. Additional wipers are available from YSI.



2.10.3 SONDE STORAGE

Since the introduction of the YSI Environmental Monitoring Systems (EMS) product line several years ago, YSI has learned a great deal about storage protocols which will maximize the lifetime of your sensors. This knowledge has come from our own extensive in-house testing programs as well as from feedback from a large number of customers and sales representatives.

Proper storage of the your Sonde between periods of usage will not only extend the life of the sensors, but will also ensure that the unit will be ready to use as quickly as possible in your next application.

GENERAL RECOMMENDATIONS FOR SHORT TERM STORAGE

The recommended short term or interim storage procedure is simple and identical for all sondes, YSI 600R, 600XL, 600XLM, 6820, 6600 and 6920.

No matter what sensors are installed in the instrument, it is important to keep them moist without actually immersing them in liquid, which could cause some of them to drift or result in a shorter lifetime. For example, the reference junction of a pH sensor must be kept moist to minimize its response time during usage, but continued immersion in pure water may compromise the function of the glass sensor and/or result in long term leaching of the reference junction.

YSI recommends that short term storage of all multi parameter instruments be done **by placing approximately 0.5 inch of water in the calibration and/or storage cup, that was supplied with the instrument, and by placing the sonde with all of the probes in place into the cup.** The use of a moist sponge instead of a half inch of water, is also acceptable, as long as its presence does not compromise the attachment of the calibration cup to the sonde. **The calibration cup should be sealed to prevent evaporation.**

The key for interim storage is to use a minimal amount of water so that the air in chamber remains at 100 percent humidity. The water level has to be low enough so that none of the sensors are actually immersed. Any type of water can be used in this protocol: Distilled, deionized, or tap water. If the storage water is inadvertently lost during field sampling studies, environmental water can be used to provide the humidity.

Sondes with level sensors have a tube that vents the pressure transducer to the atmosphere**. It is important that the air in the tube remains dry at all times.** Sondes with integral cables should be stored with the desiccant in place and the vented end of the desiccant system sealed. Sondes with connectors should be stored with the connector cap firmly in place. When disconnecting the cable, put the cap on immediately. Vented cables should be stored with their caps in place, in a bag containing desiccant.

- Interim multi parameter storage is easy. Simply remember the following key points:
- Use enough water to provide humidity, but not enough to cover the probe surfaces.
- Make sure the storage vessel is sealed to minimize evaporation.
- Check the vessel periodically to make certain that water is still present.
- For sondes with level sensors, keep the tube sealed and dry.

GENERAL RECOMMENDATIONS FOR LONG-TERM SONDE STORAGE

The following are long term storage recommendations listed by instrument type. They will be applicable for sondes with typical sensor configurations.

600XL, 600XLM -- Remove the pH or pH/ORP probe from the sonde and store it according to the instructions found in the following section on individual sensors. Cover the empty port with the provided plug. Leave the conductivity/temperature and the dissolved oxygen probes in the sonde with a membrane and electrolyte on the DO sensor. Place enough of deionized, distilled, or tap water in the calibration cup to cover the sensors, insert the sonde into the vessel, and seal with the cap/O-ring to minimize evaporation.

6820, 6920, 6600 -- Leave the conductivity/temperature and the dissolved oxygen probes in the sonde with a membrane and electrolyte on the DO sensor. Remove all other probes from the sonde and store according to the instructions found in the following section on individual sensors. Cover the empty ports with the provided plugs. Place enough of deionized, distilled, or tap water in the calibration cup to cover the sensors, insert the sonde into the vessel, and tighten the threaded cup to attain a good seal and minimize evaporation.

600R (with Replaceable Reference Electrode Module) -- Instruments of this design were generally sold after January, 1996 and can be identified by the presence of 4 probes (temperature, dissolved oxygen, pH reference, and pH glass) in the bulkhead. Remove the reference module, store it as described below, and plug the open port with the insert that was provided. Make certain that the dissolved oxygen sensor has an undamaged membrane and electrolyte in place. Place approximately 300 mL of tap water in the storage vessel, insert the sonde, and seal the vessel with the cap and O-ring. **Do not use deionized or distilled water in this case, as it may damage the pH glass sensor that must remain in the sonde.**

600 (with Combination pH Sensor) -- Instruments of this design were generally sold prior to January, 1996 and can be identified by the presence of only 3 probes (temperature, dissolved oxygen, pH) in the bulkhead. Be certain that the dissolved oxygen sensor has an undamaged membrane and electrolyte in place. Fill the provided storage vessel with a solution that is 2 molar (2 M) in potassium chloride (KCl) to a level that completely covers the dissolved oxygen and pH probes. See the following section for instructions on preparation of the KCl storage solution. Seal the vessel with the cap and O-ring.

2.10.4 PROBE STORAGE

LONG-TERM STORAGE OF PROBES

The following sections provide additional details on the storage of individual sensors associated with instruments in the 6-Series product line from YSI.

TEMPERATURE

No special precautions are required. Sensors can be stored dry or wet, as long as solutions in contact with the thermistor probe are not corrosive (for example, chlorine bleach).

CONDUCTIVITY

No special precautions are required. Sensors can be stored dry or wet, as long as solutions in contact with thermistor probe and conductivity electrodes are not corrosive (for example, chlorine bleach). However, it is recommended that the sensor be cleaned with the provided brush prior to long term storage.

DISSOLVED OXYGEN

Rapid Pulse dissolved oxygen sensors should always be stored with a membrane and electrolyte in place and in such a way that the drying out of the electrolyte on the probe face is minimized. For long-term storage, the medium should be water rather than the moist air used in interim storage. The long-term storage protocol is also dependent on the instrument under consideration.

For the 600XL, 600XLM, 6820, 6600 and 6920, two long-term storage methods are equally acceptable.

1. Remove all probes other than dissolved oxygen, conductivity, and temperature from the sonde and seal the vacant ports with the provided port plugs. Leave the electrolyte and membrane in place on the dissolved oxygen sensor. Fill the calibration cup with water (tap, deionized, or distilled are equally acceptable) and insert the sonde. Make certain the water level is high enough to completely cover the DO sensor. Seal the vessel to prevent evaporation of the water. At the end of the storage time, remove the existing membrane and re-membrane the probe using new electrolyte.

2. Remove the dissolved oxygen sensor from the sonde leaving the electrolyte and membrane in place. Store the probes in water (tap, deionized, or distilled are equally acceptable) in a beaker, flask, or other vessel of the user's choice. **Be sure not to damage the membrane or the probe tip when placing the probe on the bottom of the vessel.** If possible cover the vessel with parafilm or plastic wrap to minimize evaporation of the water during long-term storage. Monitor the water level in the storage vessel periodically and replenish if loss due to evaporation occurs. At the end of the storage time, remove the existing membrane and re-membrane the probe using new electrolyte.

Because the user cannot remove the YSI 600R's dissolved oxygen probe from the sonde, a slightly different long-term storage protocol is required:

For 600 systems equipped with a replaceable reference electrode module, remove the reference module, store it as described below and plug the open port with the port plug that was provided. Make certain that the dissolved oxygen sensor has an undamaged membrane and electrolyte in place. Fill the provided storage vessel with a solution which is 2 molar (2 M) in potassium chloride (KCl), insert the sonde and seal the vessel with the cap and O-ring. This solution can be prepared by dissolving 74.6 g of KCl in 500 mL (approximately 1 pint) of water or 37.3 g of KCl in 250 mL (approximately 0.5 pint) of water. The water should be distilled or deionized. If KCl solution is unavailable, it is acceptable to store the dissolved oxygen and pH glass sensors in tap water. **Do not use deionized or distilled water in this case, as it may damage the pH glass sensor, which must remain in the sonde.** At the end of the storage time, remove the existing membrane and re-membrane the probe using new electrolyte.

- For 600 systems equipped with a combination pH probe (purchased prior to 1996), none of the probes are user-replaceable and a different storage technique is required. Make certain that the dissolved oxygen sensor has an undamaged membrane and electrolyte in place. Fill the provided storage vessel with a solution, which is 2 molar (2 M) in potassium chloride (KCl), to a level that completely covers the dissolved oxygen and pH probes. Seal the vessel with the cap and O-ring. At the end of the storage time, remove the existing membrane and re-membrane the probe using new electrolyte.

pH

The key to pH probe storage, short or long-term, is to make certain that the reference electrode junction does not dry out. Junctions which have been allowed to dry out due to improper storage procedures can usually be rehydrated by soaking the sensor for several hours (overnight is recommended) in a solution which is 2 molar in potassium chloride (see dissolved oxygen section above for preparation of this solution). If potassium chloride solution is not available, soaking the sensor in tap water or commercial pH buffers may restore probe function. However

in some cases the sensor may have been irreparably damaged by the dehydration and will require replacement. It is also important to remember not to store the pH sensor in distilled or deionized water as the glass sensor may be damaged by exposure to this medium.

The long-term storage protocol is dependent on the instrument.

For YSI 600XL, 6820, 6600 and 6920 systems, the recommended long-term storage protocol is identical. Remove the probe from the sonde and seal the vacant port with the provided plug. Place the probe in the storage vessel (plastic boot or bottle) which was in place on delivery. The vessel should contain a solution which is 2 molar in potassium chloride. Make certain that the vessel is sealed to prevent evaporation of the storage solution.

For YSI 600 systems equipped with a replaceable reference electrode module, remove the reference module and plug the open port with the provided insert. Place the module in the storage vessel boot, which was in place on delivery, and seal the vessel with electrical tape. The vessel should contain a solution which is 2 molar in potassium chloride and should be sealed to prevent evaporation of the storage solution. Make certain that the dissolved oxygen sensor has an undamaged membrane and electrolyte in place. Fill the provided sonde storage vessel with tap water, insert the sonde, and seal the vessel with the cap and O-ring. **Do not use deionized or distilled water in this case, as it may damage the pH glass sensor that must remain in the sonde.**

For YSI 600 systems equipped with a combination pH probe (purchased prior to 1996), a different storage technique is required. Make certain that the dissolved oxygen sensor has an undamaged membrane and electrolyte in place. Fill the provided storage vessel with a solution which is 2 molar in potassium chloride (KCl) to a level which completely covers the dissolved oxygen and pH probes, insert the sonde, and seal the vessel with the cap and O-ring.

ORP

Long Term Storage: ORP is not available on the YSI 600R. For the YSI 600XL, 600XLM 6820, 6600 and 6920 systems, the recommended long term storage protocol is identical. Remove the probe from the sonde and seal the vacant port with the provided plug. Place the probe in the storage vessel (plastic boot or bottle) which was in place on delivery. The vessel should contain a solution which is 2 molar in potassium chloride. Make certain that the vessel is sealed to prevent evaporation of the storage solution.

AMMONIUM, NITRATE AND CHLORIDE

The active element in the ammonium and nitrate ion selective electrode (ISE) sensors is a polyvinyl chloride (PVC) membrane that is impregnated with the reagent that provides specificity for either ammonium or nitrate. The useful life of this sensor can be reduced if the membrane is stored immersed in water. Thus, storage in dry air is recommended for long term storage. While dry air is slightly preferable for general storage, the short-term storage of these sensors in the sonde, with the entire sensor array in moist air, will have no significant detrimental effect on the life of the membrane. Remove the sensor module (6820, 6600, 6920) or the probe from the sonde and cover the vacant port with the provided plug. Place the sensor back in the storage boot that was provided, and set aside in room air.

The chloride ISE sensor utilizes a solid state membrane that provides specificity. For long-term storage, the module should be removed from the sonde, wiped clean with moist lens cleaning tissue, and placed in its storage boot to prevent abrasion.

TURBIDITY AND CHLORPHYLL

No special precautions are necessary for either the short or long-term storage of the chlorophyll and turbidity probes. However, for long-term storage, the user may wish to remove the probe from the sonde, replace it with a port plug, and store the probe in dry in air to minimize any cosmetic degradation of the probe body and to maximize the life of the wiper.

DEPTH AND LEVEL

No special precautions are required for the sensor itself, but see instructions above with regard to maintaining a dry atmosphere in the vent tube. Sensors can be stored dry or wet, as long as solutions in contact with the strain gauge sensor port are not corrosive (for example, chlorine bleach).

Recommendations are identical for short-term and long-term storage.

SECTION 3 DISPLAYS AND LOGGERS

3.1 GETTING STARTED

The YSI Display and Logger series instruments are powerful, hand held microcomputers that allow the user to display sonde readings, configure sondes, store and recall data, upload data from sondes and transfer data to computers for analysis and plotting.

3.1.1 BATTERIES AND CHARGING

An internal NiMH battery pack powers the YSI 610. This supply is sufficient to run a YSI 610 connected to a sonde for 6-8 hours. If the sonde is being powered separately, the YSI 610's batteries can last much longer. The sondes can be powered by their internal batteries (6920, 6600 and 600XLM only), or by using a power supply such as the YSI 6038.

To ensure that you get maximum operational time from your hand-held display/logger, the user should follow the procedures below:

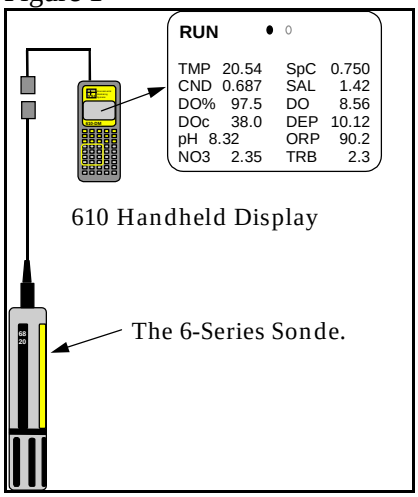
1) Place your display/logger on charge for approximately 24 hours.
2) After 24 hours, take the display/logger off the charge and switch it on. Leave the display/logger on until the battery is fully discharged.
3) Repeat steps one and two at least two more times. This ensures that the battery is charged to its maximum capacity.
4) Do not charge the batteries for more than 48 hours.

If the above steps are not followed, it may result in limited operational time of your display/logger and limited lifetime of your terminal's battery pack. When the YSI 610's batteries get low, the YSI 610 beeps. This provides approximately a one-hour warning before the YSI 610 will turn itself off. A wall-mount power supply is supplied with the YSI 610 to recharge the batteries. An optional automotive cigarette lighter adapter is also available.

3.1.2 CONNECTING TO A SONDE

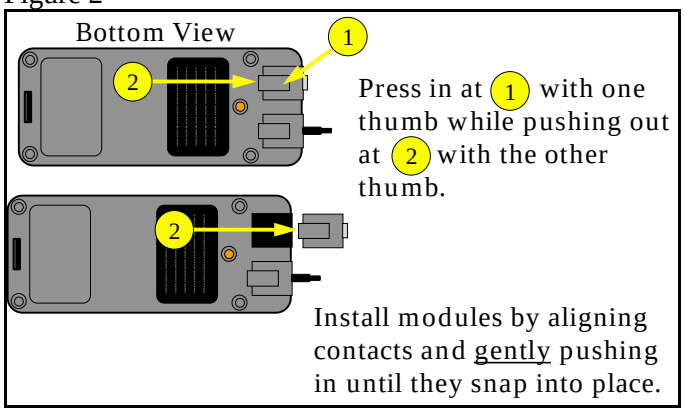
Since YSI 6-Series sondes do not have displays or controls, users must communicate to them with a PC or terminal and emulation device. Figure 1 is a diagram of the YSI 610 connected to any 6-Series sonde.

Figure 1



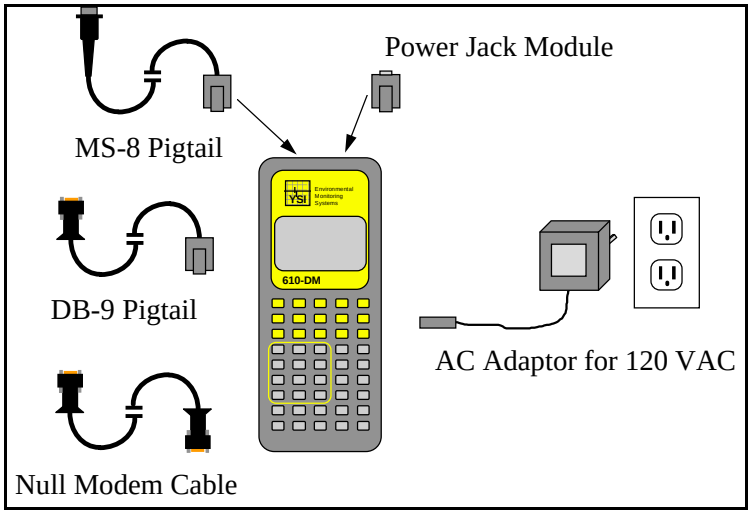
There are two slide plugs on the back of the YSI 610. One plug is for power and the other is for communications to a sonde or computer. They are not interchangeable. In a laboratory situation, you will often use the AC adapter plug to power and charge your YSI 610. Because this plug is not intended to be watertight, replace it with the blanking plug when taking the YSI 610 into the field. An optional slide plug adapter for connecting your YSI 610 to an external battery is also available.

Figure 2



Two slide plug cable adapters are available for the communications plug. One is for communication with a PC and terminates in a 9 pin miniature sub-D connector (DB-9). When communicating with a PC, be sure to use a null modem cable. The other adapter is for use with a sonde and terminates in an 8 pin, military style connector (MS-8). Plug the MS-8 end of the cable into the sonde cable and the other end into the YSI 610.

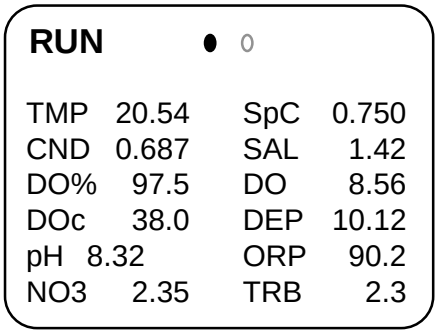
Figure 3



3.1.3 POWERING UP

After the YSI 610 is shipped, the batteries may need a few minutes of charging before the unit can be turned on. Normally, whenever the AC adapter is plugged in, the YSI 610 turns itself on. To turn the YSI 610 off when the AC adapter is plugged in, press the Power button, wait for the power up display to appear and then press the Power button again. Do not allow the YSI 610 to charge more than 48 hours continuously.

With a sonde plugged in, the YSI 610 powers up into the Run mode and displays readings.



The message, “No Sonde in Use” may appear occasionally while the YSI 610 is trying to establish communication to a sonde. If the message does not go away after 60 seconds check the cables, power and baud rate selection on both the YSI 610 and the sonde to make sure that they are working properly, and that the baud rates agree (See **Section 2, Sondes** for information about the proper baud rate).

3.2 USING THE KEYBOARD

To select different menu options, use the arrow keys to highlight the name of the menu that you want to open, and press the **Enter** key. To return to the previous menu, press the **Esc** key.

Information can be entered into the YSI 610 when you see a blinking cursor within a highlighted item. If you wish to change the highlighted information, type in the new information, and press **Enter**. You can enter information in upper or lower case.

Durations and intervals, which appear on logging and deployment menus, are entered in a special way. Values may be entered in units of seconds (s), minutes (m), hours (h) or days (d). You must type a number followed by a letter (press Shift after typing the numeric portion). Thus 15 seconds is entered as "15s", and 36 hours is entered as "36h".

The upper right corner of the screen indicates the keyboard shift status by showing "shft" or "caps". If you wish to type a number instead of a letter, press the shift key and “shft” will disappear. When the “shft” appears in the upper right corner of the screen, letters can be typed. The YSI 610 automatically changes the shift status when it expects numeric/text input. The “caps” appears in the upper right corner when you hit the caps key to type capitalized letters (useful for naming files).

When the menu is too large to fit on the screen, arrow symbols appear in the upper or lower corners. To see the part of the menu that is not shown, use the Arrow keys, and the screen will scroll as necessary.

3.3 CHOOSING WHICH READINGS TO DISPLAY

The Setup Sensors and Setup Parameters menus of the YSI 610 allow you to display or change the active sensors and parameters that are in the sonde. Both menus are listed in the Main menu and have similar formats. To select or deselect an item in these menus, highlight it and press **Enter**. You will rarely use the Setup Sensors menu, except when you are first setting up your sonde after purchase, and only occasionally use the Setup Parameters menu.

The Setup Sensors menu in the YSI 610 can not detect the presence or absence of a particular sensor in the sonde. So regardless of which sensors are installed in your sonde, all possible sensors are listed in the YSI 610 Setup Sensors menu. If you activate a sensor that isn't really connected, you will see false readings for that sensor, because the YSI 610 and the sonde will believe whatever you enter.

RUN MODE

You access the Run mode by selecting Run from the YSI 610 Main menu, or by powering up the YSI 610 with a sonde already connected. In the Run mode, the YSI 610 constantly requests live data from the sonde and displays it on the screen. To go to the YSI 610 Main menu from the Run mode, press the **Esc** key.

3.3.1 SETTING UP AND USING THE SITE LIST

A feature of the YSI 610-DM (but not the YSI 610-D) allows you to place a list of "site names" into memory to eliminate having to type them in during fieldwork. While using the YSI 610-DM in the Run mode, you may press the "C" key (capture), "A" key (add) or "M" key (marked) to view the Site List. Choose a site name from the list, or type in a new name and confirm creating a new file if necessary. Press **Enter**, and the data will be added or captured to this file. Each of these features are discussed in further detail in this section.

There are two approaches to setting up and using the Site List feature. One allows you to designate a descriptive file name and then add or capture data to this file at various times. For example, you may decide to sample at "bridge1" each day for 14 days and capture readings for several minutes each time. When you review or upload this file it will contain 2 weeks of data, time and date stamped. This data is specific to "bridge1" site and all of the data are in one file. If you want to collect data at another site (e.g., "bridge2"), you need to open a second file.

The second approach allows you to collect all readings for a particular field trip into one file. For example, you may decide to sample at "bridge1", then "bridge2", then to "uplake", and so on. When setting up this file (automatically named "marked" by the YSI 610-DM), you list a descriptive name in the "file" prompt to describe the site, then assign a number in the "site" prompt that corresponds to this site. This mark number is important because it is the key identifier when you view the readings at a later time. Again, the advantage of "marked" file is that you can store readings from many sites in one file and be able to identify the sites later. This may be your approach of choice on a one day trip to multiple sites.

USING THE SITE LIST WITH THE MARKED FILE

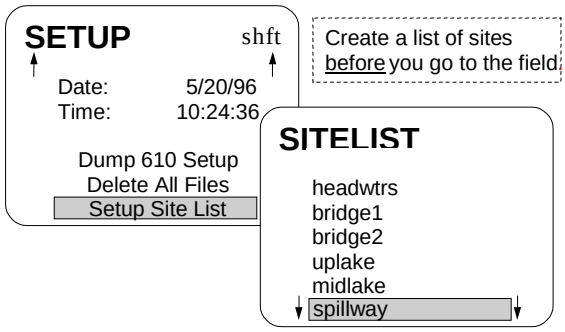
The **Site List** is accessed through the **Setup YSI 610** menu. If the site list is empty, "make NEW entry" appears and prompts you to type in a new file name.

When using the Mark feature, there is only one file name, "marked". All readings that are stored using the "m" prompt during Run mode are stored to the file name "marked".

IMPORTANT: You can only set up "marked" file by pressing the "**m**" key in the **Run** mode. You can not type in the word "marked" to create this file. Once you have collected readings under the pre-assigned site names, you may rename "marked" file to a file name of your choice using submenu FILES.

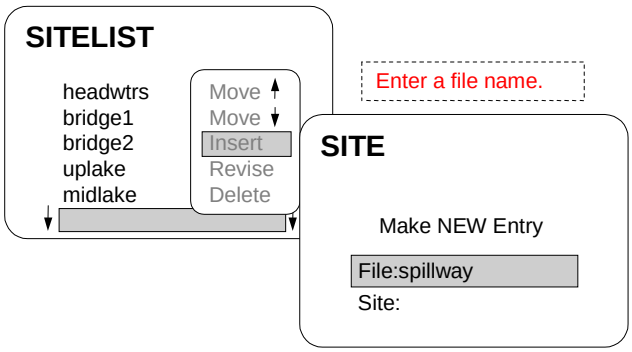
In this mode, you can set up a site list using a Mark Name and a Mark Number. In the Site List use the File item to hold the Mark Name, and the Site item to hold the Mark Number. Use any combination of alpha/numeric characters (we recommend using 8 characters max for compatibility with DOS based systems) for the Mark Name, but for the Mark Number you must enter numeric values (-99999 to 999999). You will likely use positive numbers beginning with 1, then 2 and so on.

From the YSI 610's Main menu, select **Setup YSI 610** and then select **Setup Site List**. If no sites have been entered, the "make NEW entry" screen appears. To modify an existing list, press **Enter**, then choose from the pop-up menu. To enter a new site, choose Insert. Using the example shown, type in "spillway" and press **Enter** to add to the list.

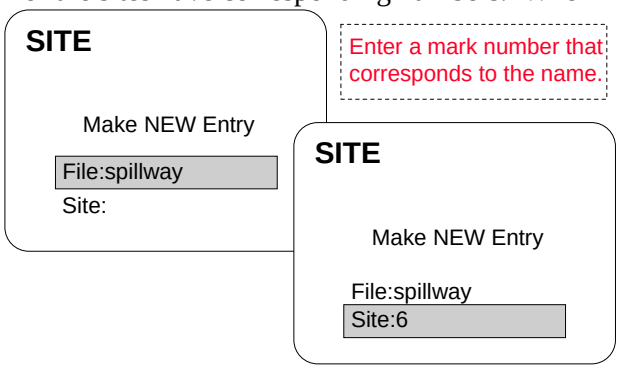


To correctly format this site for Mark status, highlight "Site" and enter a numeric value to complete this entry. Using this example the number "6" is used to identify the site "spillway".

While in the Run mode, press the "m" key. Select the site name by highlighting it to begin the process of collecting readings.



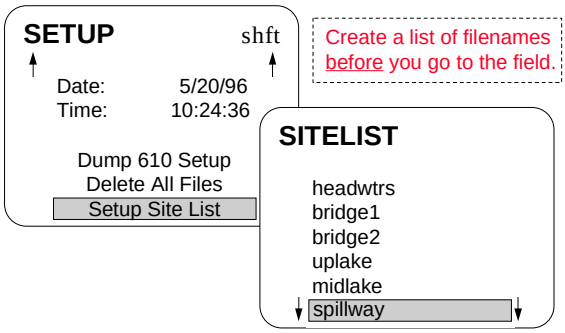
Remember that when you review data from the "marked" file, lines of data from the site "spillway" will be labeled as "sample 6". Each of the sites have corresponding numbers. When you set up the sites, we recommend that you write down the list for later reference to correlate names with numbers.



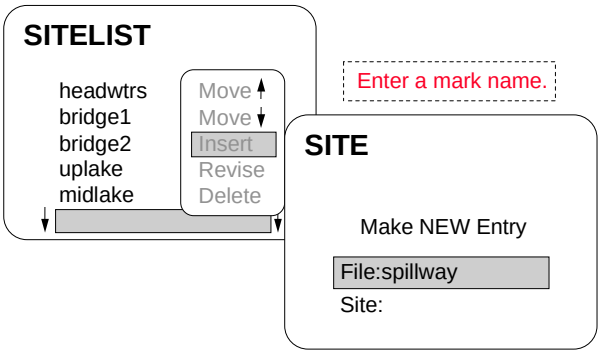
USING THE SITE LIST FOR CAPTURE, LOG AND ADD FILES

The **Site List** is accessed through the **Setup YSI 610** menu.

From the YSI 610 Main menu select **Setup YSI 610**, and then select **Setup Site List**. If no sites have been entered, "make NEW entry" appears. To modify an existing list, select an existing name, press **Enter** and choose from the pop-up menu. To enter a new site, choose Insert. Type in "spillway" and press **Enter** to add to the list.



By typing information after "Site:", you may further describe your site. This will not appear in the file name list. The information typed under "Site" only appears in the header information during review of files using the YSI 610 or YSI software. No entry is required under "Site" for Add, Capture and Log functions. A numeric value is required if the Mark function is used.



The Site List can be kept in any order. It is suggested that you arrange it in the order that you visit your sites. Making an entry on the Site List does not create a file, it only stores a file name for future use. The file name will not appear in the Site List until data is stored in the file.

There are different kinds of files for each of the three types of storage: Add, Capture and Log. The file type is fixed after the first set of readings is stored to the file. If you decide to use more than one type of storage, then you might want to make that clear in the file name itself by adding "c", "a", or "l" as a suffix to the file name.

3.4 LOGGING

Logging refers to the collection of a set of readings at regular intervals. There are two different applications of the YSI 610 related to logging.

Some 6-Series sondes (6920, 6600 and 600XLM) have on-board memory and power. These sondes can log readings to sonde memory for days or weeks at a time. You may use the YSI 610-D or YSI 610-DM to setup one of these sondes for deployment, disconnect the sonde and allow it to log readings on its own. Then use the YSI 610 to upload files from the sonde.

The second application uses YSI 610-DM memory to store readings from any of the 6-Series sondes. Since the readings are being logged to YSI 610-DM memory, sonde memory and on-board power are not required. During logging, the YSI 610 can not do anything else. While the YSI 610 can readily withstand short exposure to rain, it can not be left out in the weather for extended periods of time. For these reasons, the YSI 610 is best suited for short term logging applications.

LOGGING TO THE YSI 610-DM

The YSI 610-DM can log sample data directly to its internal memory from any 6-Series sonde. Logging produces a file in the standard YSI file format, capable of being uploaded to a PC and processed by EcoWatch for Windows.

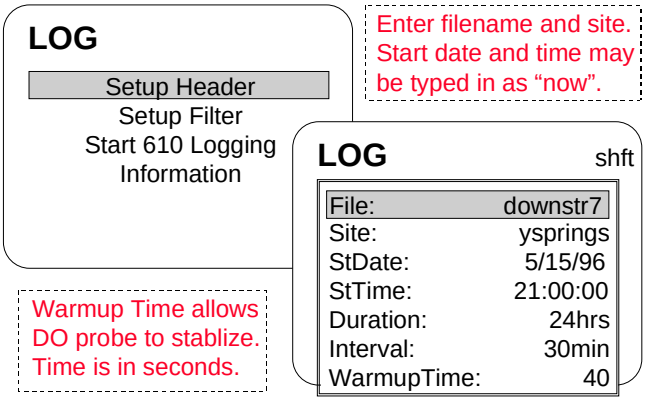
NOTE: If you log files to the 610DM, only the parameters that are active in the Report Menu will be available to the PC software. For example, if only DO mg/L is activated in Report during logging, it will not be possible to later generate DO% values. This is different from files that are logged to sonde memory where DO% would be available as a calculated parameter in EcoWatch software. It is important to be certain that all desired parameters are active in the Report Menu before beginning a 610 logging study.

When logging with the 610DM, the sensors will be turned off between logged samples, affecting the manner in which the DO calibration should be carried out. First, when setting up the sonde, the DO warm up time in the sonde's Advanced Sensor menu is set to the same value as the DO warm up time that is used to set up the 610DM logging study. Second, After establishing the connection between the sonde and the 610DM, you must turn on Autosleep RS232 in the sonde's Advanced Setup menu. This can be done by using Smart Terminal as described in **Section 3.7.3, Communications.** Third, proceed directly to the Calibrate menu of the 610DM after Autosleep is activated. If you activate Run mode, Autosleep will be deactivated. Follow the calibration procedures for DO as described in **Section 3.7.4, Calibration Mode**. The calibration will occur automatically after a countdown of the warm up time. Finally, proceed to the Logging menu and begin the study as described below.

To begin logging with any sonde, select the **Logging** menu from the YSI 610 Main menu. Four sub-menu choices are displayed.

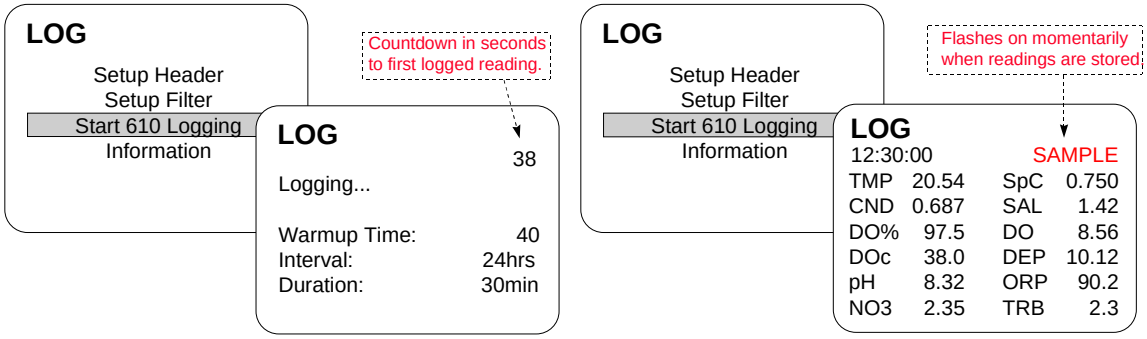
(1) The **Setup Header** menu allows you to specify control and timing information for the deployment. Be sure to set a file name and an interval. We recommend that warm-up time be set between 40 and 60 seconds.

(2) The **Setup Filter** menu allows you to automatically discard samples that do not meet your criteria. This feature is rarely used.

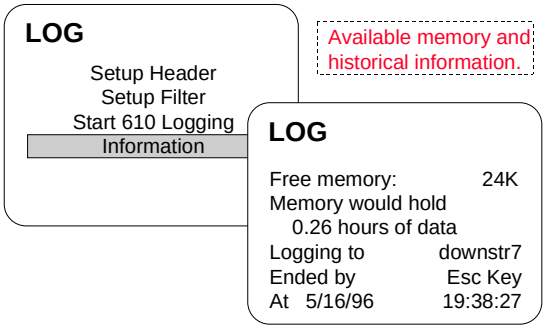


(3) The **Start YSI 610 Logging** menu begins the logging session that was specified in the Setup Header and Setup Filter menus. If the file name specified already exists and was created by Logging on the YSI 610, new data will be appended to the file. If the file name does not exist, you will be asked if you want to create it, asked to enter a site name, and asked if you want to enter the weather info. Pressing the **Esc** or **Power** keys terminates logging. Logging stores all parameters to the data file even though only 12 fit on the screen.

If the sonde is equipped with a wiping turbidity probe, the probe will be cleaned automatically before each sample but only if time permits. Cleaning takes up to 24 seconds, and the YSI 610-DM makes sure that cleaning will end at least 30 seconds before the sample. You set the number of wipes in the Sonde main menu, see **Section 2.9, Sonde menu.** When the YSI 610 is started, the number of wipes is included in the Logging screen. This allows you to verify that wiping will occur.



(4) The **Logging Information** screen tells you how much space is available for additional logging, and how much time this corresponds to in Logging mode.

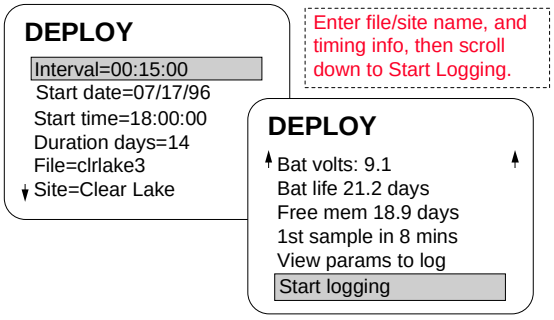


3.4.1 SETTING UP A SONDE FOR UNATTENDED LOGGING

The data logging discussed here refers to logging by the sonde into its own "sonde" memory. This logging is completely separate from the YSI 610-DM Logging, Capture and Add features which record data into the YSI 610-DM memory. The function of the YSI 610 is to communicate with the sonde, to set logging parameters and to start or stop the logging function. (Note that sondes without batteries must have an external power source to log.)

To set up a sonde for logging, select **Deploy Sonde** from the Main menu.

The YSI 610 communicates with the Sonde Main menu. Choose **Run** and then choose **Unattended Sample**. Enter a file name and a logging interval, then choose the last item on the menu, **Start logging**. Finally, the sonde asks for confirmation before actually starting the logging run. Logging will begin at the next even multiple of your logging interval.



Before starting, you should check **Free Mem** and **Bat Life**, to make sure that you have the capacity to log for your intended deployment time. It is strongly recommended that you log a few readings and view them before deploying the sonde. This will verify that you have set it up properly.

3.5 FILES

3.5.1 UPLOADING LOGGED FILES

Uploading a file from a sonde does not change the sonde files in any way. Only formatting flash disk will delete files. To upload the data in a file, you do not need to stop logging.

If you get a "No Sonde" message that persists for more than a 60 seconds, check the cabling, batteries or power, and baud rate.

From the YSI 610 Main menu go to the **Communications** menu and select **Kermit YSI 610 < Sonde**. You will see the sonde's **File** menu. From that menu choose **Upload**. A list of files will be displayed. Select the file you want and then select **Proceed**. After choosing a file format, the upload will begin. You will see several status counters on the YSI 610 screen. Any errors that occur during the upload are detected and corrected by the YSI 610. But if the counters do not advance, press **Esc** to abort the upload, and try again.

If the file is the last file in the directory (or the currently-active file), you may use the Quick Upload selection to upload the entire file.

When the upload is done, you will see "Successful" on the YSI 610 screen. Press the YSI 610's **Esc** key twice to get back to the YSI 610 Main menu. Then select **File System** and press **Enter**. You may now view the data file.

3.5.2 TRANSFERING FILES TO A COMPUTER

Run EcoWatch for Windows software on your PC, then select **Settings** from the Comm menu. Verify the Baud Rate is 9600, and that the Com port is correctly assigned. Change them if needed. Select **Sonde** from the Comm menu and press **Enter**. A blank screen will appear.

Connect the null modem cable to the appropriate PC com port. Connect the other end of the null modem cable to the YSI 610 DB-9 pigtail PC adapter. From the YSI 610 Main menu, select System Setup and verify that the Baud Rate is 9600 (or matches the PC). Change it if necessary.

From the YSI 610 Main menu select **Communications**, then select **Kermit YSI 610 > PC**. Select the file you wish to send, or select **Send All Files** (at the bottom of the list). If a file by the same name already exists in the PC, EcoWatch for Windows will ask you if you want to overwrite the PC file. If you do not want to overwrite, press N, and type in a different file name.

During the upload, you will see several status counters on the YSI 610 and PC screens. Any errors that occur during the upload are detected and corrected by EcoWatch. But if the counters do not advance, press **Esc** at both the PC and the YSI 610 to abort the upload, and try again. When the upload is complete, the status will read "Successful". Press Esc on the 610 to return to the Main menu.

3.6 SAMPLING

Sampling applications refer to readings that are taken while the user is present and controlling the collection of data.

In sampling applications the total data collection time is relatively brief, from a few minutes to perhaps a few hours. **Examples:** taking one set of readings at the outfall of a wastewater treatment plant once a day, taking readings at one mile intervals along the length of a river, checking the DO concentration once a week in several ponds, or spending an entire day profiling a lake.

The YSI 610 has several powerful features that make data collection easy during applications. Because the interpretation and use of the Site List depends on which feature you use, we recommend that you choose one method that best suits your needs, learn that method and ignore the others. The following chart lists the major features of each type of memory. The rest of this section explains in detail the uses of each type.

Stash Simplest way to store readings
Data is not intended to be uploaded to a PC
Data is stored in 26 slots, each referred to by letter (A-Z)
Weather data can be stored in the same way

Add Stores single sets of readings to an uploadable file
Only available on the YSI 610-DM

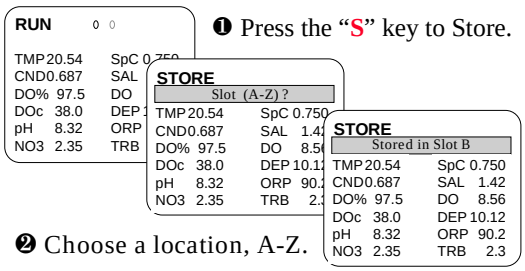
Capture Stores several consecutive readings to an uploadable file
Only available on the YSI 610-DM.

Mark Stores readings from many sites in a single, uploadable file
Only available on the YSI 610-DM.

3.6.1 STASH MEMORY

Stash memory is available on both the YSI 610-D and YSI 610-DM display/loggers.

While in the Run mode, you can store readings to the Stash memory. To store a set of readings, simply press the "**S**" key, then at the prompt press any letter to choose a "slot".

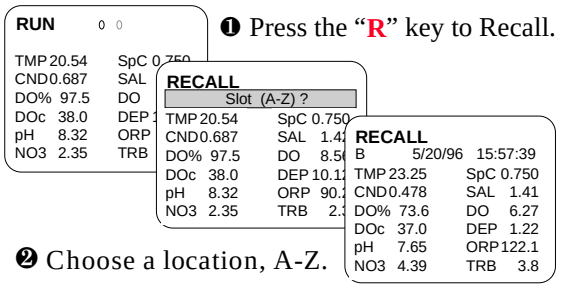


❶ Press the "S" key to Store.

❷ Choose a location, A-Z.

❸ Message appears to verify location.

To recall a set of readings later, press the "**R**" key and then press the letter corresponding to the slot where the readings are stored. These slots are not deleted but can be overwritten. You must be in the Run mode to use the Recall function.



❶ Press the "**R**" key to Recall.

❷ Choose a location, A-Z.

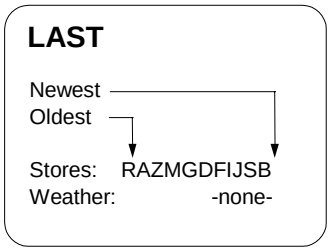
❸ Stored data displayed until **Esc** pressed.

There is an additional sets of slots, one for storing weather information. To store weather information, press the "**W**" key and press any letter key to select a slot. You are then presented with a form where you can record wind speed, precipitation, sky conditions and other weather-related information.

Note that Stash memory for readings and weather are organized into slots referred to by letters. These three sets of letter slots are independent of each other. However, you may choose to use the same letter when storing weather and readings from the same site.

To check the status of Stash memory or weather press the "**L**" key during Run mode to view the screen to the right. This screen displays the last 11 entry slots in the order in which they have been used.

Press "**L**" key from Run mode to the last 11 Stores and Weather locations.



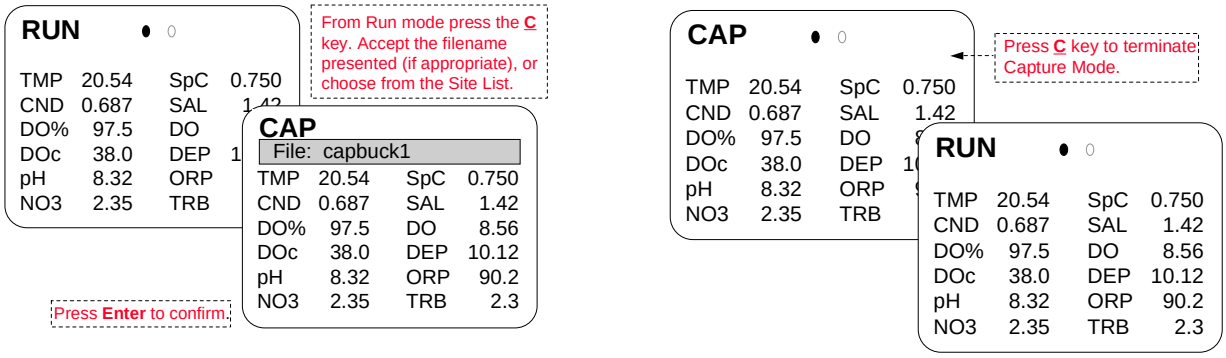
3.6.2 CAPTURE AND ADD MEMORY

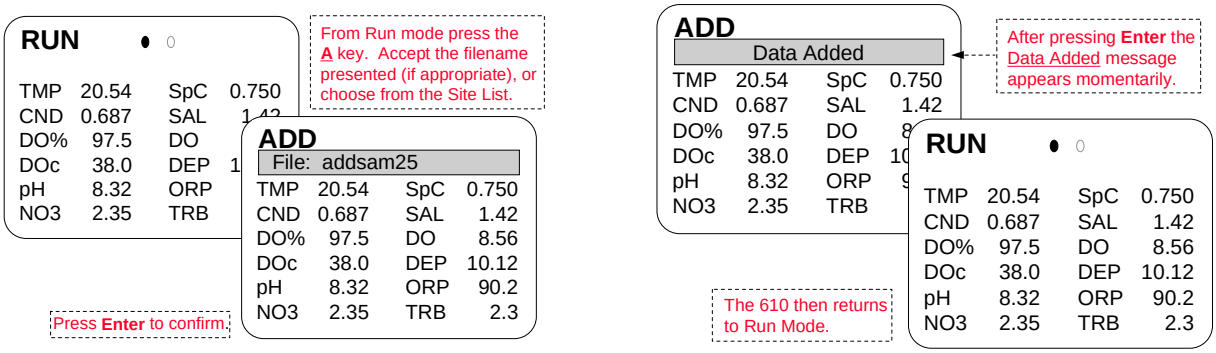
Capture memory stores readings to a file as quickly as they come from the sonde. From Run Mode press the "**C**" key to start Capture. Stop it by pressing "**C**", **Esc** or **Power**. When you press "**C**", readings will resume being displayed in the Run mode. When you press **Esc**, you return to the Main menu. When you press **Power**, the YSI 610 turns itself off.

Add memory stores a single set of readings to a file. From Run Mode press the "**A**" key to start Add. Once the reading is stored, the display returns to Run mode and "live" readings continue to be displayed. You may store as many readings as you like by pressing the "**A**" key repeatedly. In all other respects the Capture and Add features are the same.

After pressing "**C**" or "**A**", enter a file name. You may press the down arrow key to view additional site names on the Site List, or you may enter a new site name (file name) in the highlighted area.

Remember that if a file is open and has been activated as a Capture or Add file, you can only capture readings to a Capture file and only add readings to an Add file.





3.6.3 MARK FEATURE

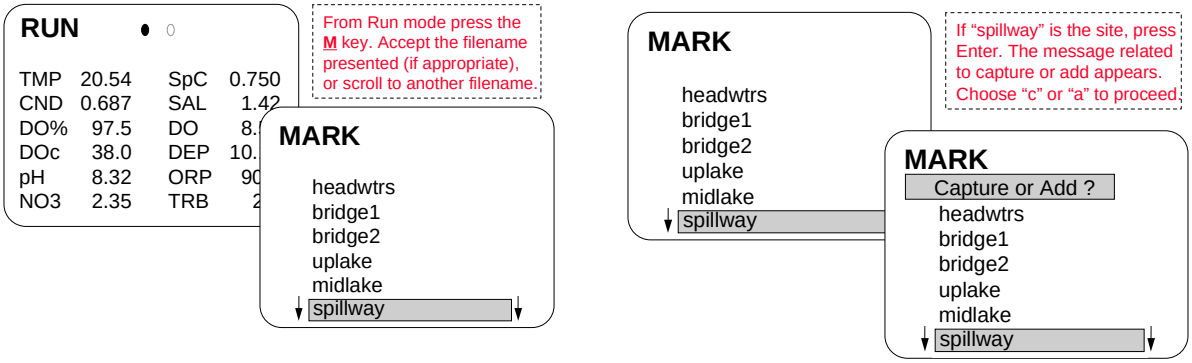
The Mark feature of the YSI 610-DM allows you to store data from several sites into a single file. You can only create a marked file using the "M" key prompt during Run mode. You may upload the file to YSI EcoWatch for Windows software just like any other data file.

Example: A typical application would be a horizontal profile on a river or lake studying the effect of location on readings. At each site, you would place the sonde in the water, wait for readings to stabilize, select a name from the Site List, and store a set of readings in the "marked" file. At the end of the study, you will have one file with data from many sites. Each set of readings includes a Mark Number identifying which site the readings came from.

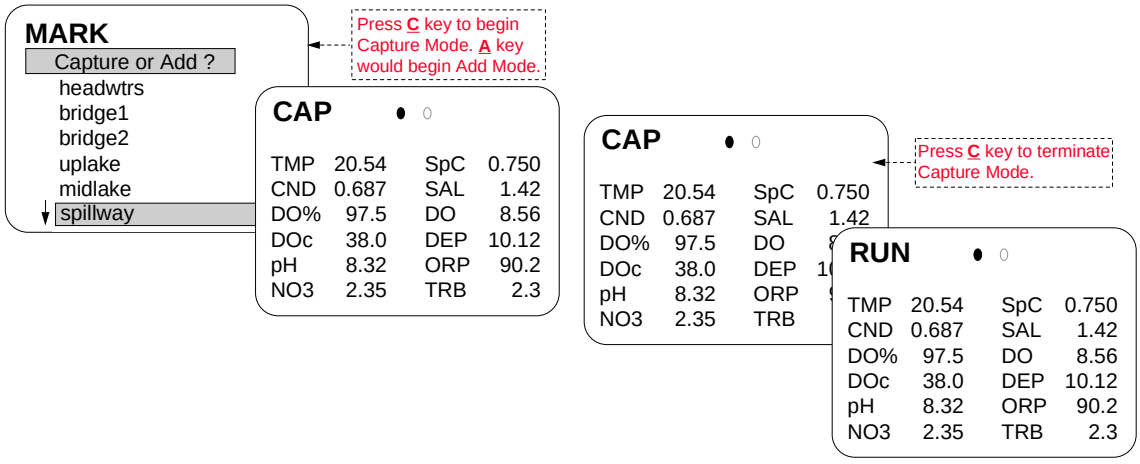
To use the Mark feature, start by building the Site List. Normally, the Site List includes pairs of file names and site names. Marked data goes to only one file named "marked". Since there is no need for other file names, the YSI 610 interprets the Site List as pairs of site names and site

numbers. Use the Site List "File" item to hold the Mark Name. Use the Site List "Site" item to hold the Mark Number. The Mark Name can be anything you wish, but the Mark Number must be numeric, -99999 to 999999, usually 1, 2, 3, 4, etc. The YSI 610-DM stores a site number in the data file, not a site name so it is important to remember the association of the number with the name.

After building the Site List you are ready to use the Mark feature. You may choose to add a single set of readings to the Marked file, or capture sets of readings to the Marked file as fast as they come from the sonde. Start by pressing the "**M**" key while in Run mode. Choose a name from the Site List. Next, choose whether to Capture or Add.

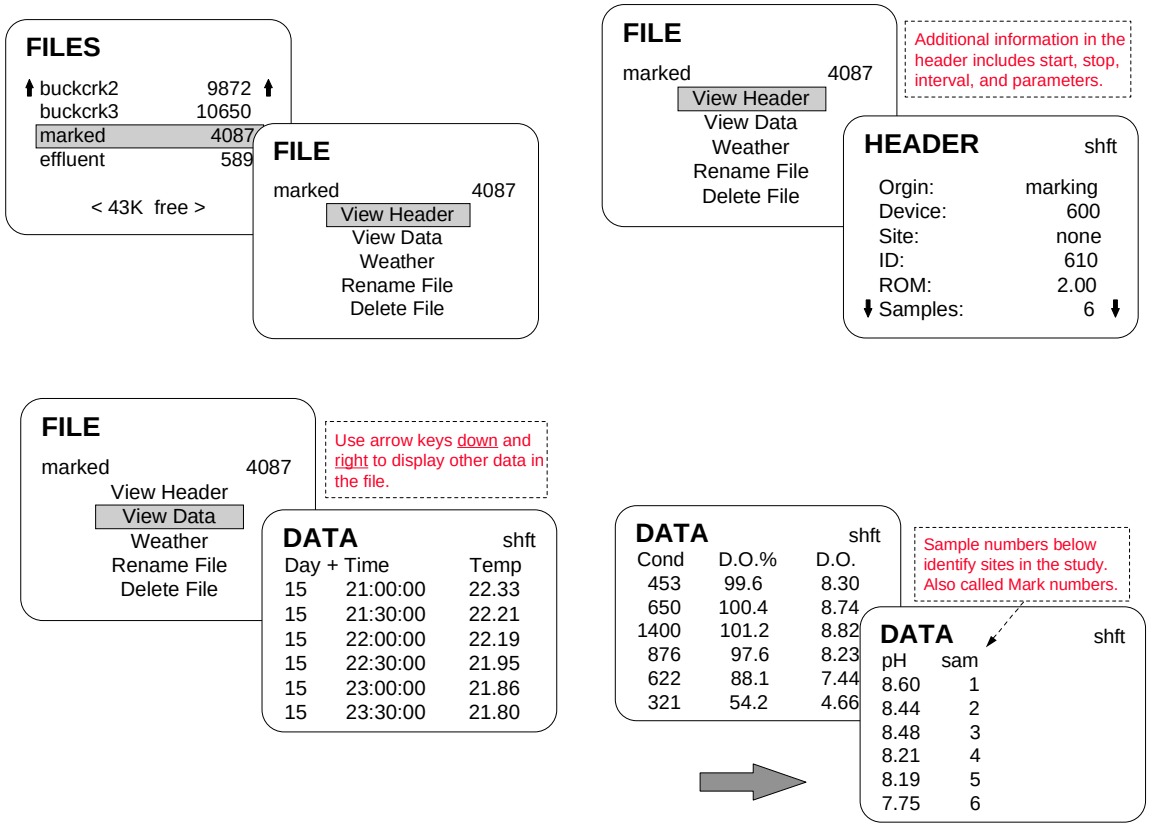


From this point, proceed as any other time you would Capture or Add. Press "**C**" or "**A**". If it is the first entry to the Marked file, the YSI 610-DM prompts "New File yn?". Press "**Y**" to create the file. The YSI 610 then prompts you for Weather information. If you want to enter Weather information, press "**Y**" and enter information. Otherwise, press "**N**". Next, the YSI 610 indicates that it has added a single set of readings to the file or that it is capturing data to the file. To terminate Capture, press the "**C**" key again. You do not need to terminate the Add operation since the YSI 610 automatically returns to the Run mode display.



With each set of readings the YSI 610 stores the date and time and a Mark Number. The Mark Number appears just like an extra parameter, although it does not appear on the screen in Run

mode. The Mark Number will only appear when viewing the file in the YSI 610 Files menu, and in YSI software on the PC. All sets of readings in the marked file must have the same parameters.



YSI PC software will interpret the Mark Number just like any other parameter. Viewing the data in table format, you will see columns for each of the readings (Temperature, DO, pH, etc.) and an extra column for the Mark Number. EcoWatch labels the column “Unknown”. Both programs can easily print a report in table format.

If you plot the data, there will also be a plot of the site number. Furthermore, readings from all sites will appear end to end as they are in the file. Plots may not be appropriate for your application. If you prefer to use other analysis software, YSI software can export the data in CDF or ASCII format.

Things to remember about the Mark feature:

- The YSI 610 stores all Marked data in a special file named “marked”. The YSI 610 stores a site number with each set of readings, not a site name.
- Only one weather entry is possible for the entire marked file. You cannot enter different Weather data for each site or for different days.
- Before using the Mark feature, you must define pairs of site names and site numbers in the Site List.

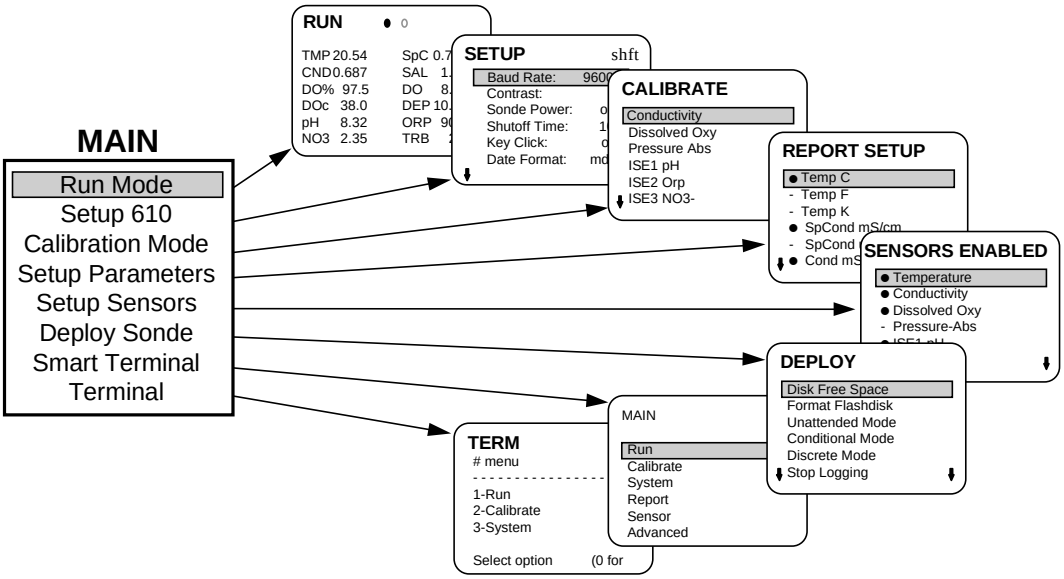
- All sets of readings in the marked file must have the same parameters.

- To store marked data in a different file, rename the current Marked file using YSI 610 File System. The renamed file still contains a Mark Number for each set of readings. Additional marked data will be stored in a new file named “marked”.

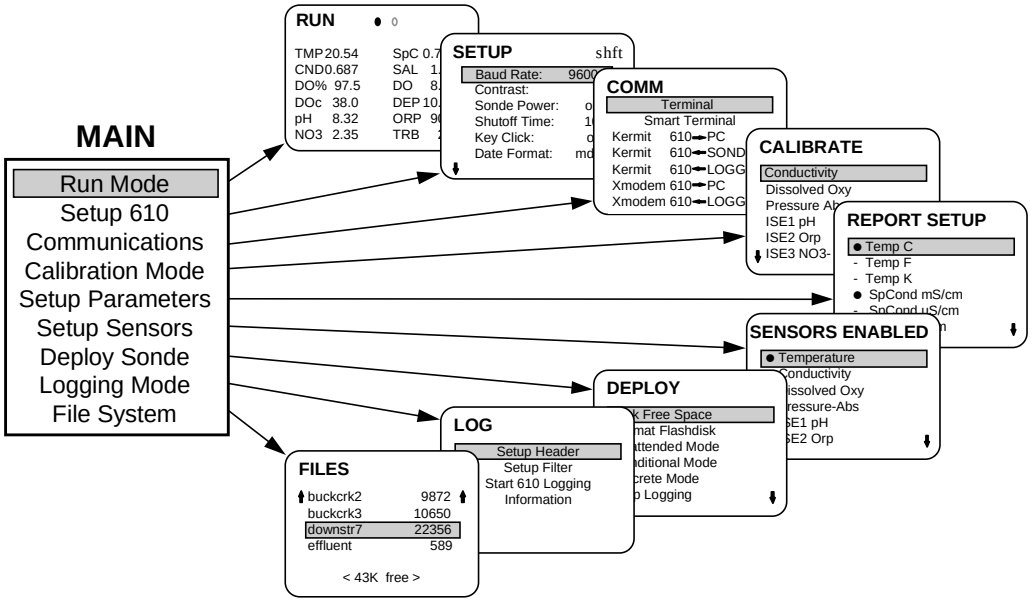
3.7 YSI 610 MENU

To help you access the many features of the YSI 610, its features are grouped into menus. Each menu has several items on it. An item can perform a function, such as deleting a file, accepting and displaying information, entering the time, or providing access to a sub-menu.

610-D Menu



610-DM Menu



3.7.1 RUN

You access the Run mode by selecting Run from the YSI 610 Main menu, or by powering up the YSI 610 with a sonde already connected. In the Run mode, the YSI 610 constantly requests live data from the sonde and displays it on the screen. To go to the YSI 610 Main menu from the Run mode, press **Esc**.

When 6 parameters or fewer are selected, data are displayed double-sized. If more than 12 parameters are selected, you may scroll to see all additional parameters.

Pressing H in Run mode displays the Help screen. The Help screen displays the special keys that are active in Run mode. These keys can be pressed while in Run mode, or when the Help screen is showing. The keys are as follows:

C Turn Capture mode on/off (YSI 610-DM only)
A Add a reading to a file (YSI 610-DM only)
S Store a reading
M Capture or Add readings to the Marked File (YSI 610-DM only)
R Recall a reading
W Local Weather
L Show Last 11 Stores/Weathers
T Clean turbidity and/or chlorophyll probe attached to sonde
H Show Help screen

WEATHER

Sometimes, it is useful to record local weather details during a field trip. The YSI 610 provides 26 handy Weather slots, each capable of holding a complete description of the local weather. These slots are completely separate from the Weather information that is attached to each file.

You enter or view the 26 Weather slots from the Run mode by pressing W and then a letter A-Z. Slots are never erased, but can be edited as needed. When you make changes, the Weather slots are automatically time-stamped. To quit the Weather slots without making changes, power off the YSI 610 and power up again.

The Skip key advances you to the next-used Weather slot (in alphabetical order). The L function reminds you what you have changed lately.

Station: The name of the station (or site)
Date: Shows the last date that this Weather slot was used
Time: Shows the last time that this Weather slot was changed

TIME OF NEAREST

Low Tide: Enter the time of the nearest low tide
High Tide: Enter the time of the nearest high tide
Ebbing? Press enter if the tide was ebbing
Flooding? Press Enter if the tide was flooding

Beaufort Scal:	Enter the Beaufort Scale number
Wind Dir:	Enter wind direction as compass point (e.g. WSW) or in degrees
Wind Speed:	Enter wind speed (any units)
Wind Still?	Press enter if the wind is still
Wind Light?	Press enter if the wind is light
Wind Gusty?	Press enter if the wind is gusty
Wind Strong?	Press enter if the wind is strong
Barometer:	Enter barometric pressure (any units)
Cloudless?	Press enter if the sky is cloudless
Partly Cloudy?	Enter barometric pressure in any units
Overcast?	Press enter if the sky is overcast
Fog/Haze?	Press enter if the sky is foggy or hazy
Drizzle?	Press enter if it is drizzling
Intermit Rain?	Press Enter if there is intermittent rain
Raining?	Press enter if it is raining
Snowing?	Press enter if it is snowing

24 HOUR PRECIP

None?	Press Enter if 24-hour precipitation has been zero
Light?	Press Enter if 24-hour precipitation has been light
Heavy?	Press Enter if 24-hour precipitation has been heavy
Inches:	Enter the inches of precipitation in the last 24 hours

SECCHI DISK

Extinction:	Enter YES or NO
Disapp(m):	Enter the depth that the disk disappears (meters)
Reapp(m):	Enter the depth that the disk reappears (meters)
TotDep(m):	Enter the total depth (meters)

LAST 11 STORES

Press L in Run mode. The screen displays the most-recent 11 Store slot letters, in chronological order, based on the time stamp when they were Stored. Similarly, the last 11 Weather slots are displayed, based on the time stamp when they were last changed.

CLEAN TURBIDITY AND CHLOROPHYLL

Press T in Run, Capture, or Calibration mode, to clean the turbidity and chlorophyll probes connected to the sonde. A message tells you how long the process will take.

The wiper motor puts a significant load on the YSI 610's batteries. If you are using wiped turbidity or chlorophyll, we recommend that you have NiMH batteries for your YSI 610 and that you take particular care to keep them charged according to the instructions in **Section 3.1.1, Getting Started.**

When the batteries are nearly discharged, it is possible that they may not be able to power the motor. In this case, the message will show twice the normal time for cleaning.

3.7.2 SETUP YSI 610

Select Setup YSI 610 from the YSI 610 main menu. This menu allows you to adjust the operation of the YSI 610.

Baud Rate: For communicating with a sonde or PC, the baud rate is usually 9600. The default value is 9600.
Contrast: Contrast for the LCD screen (0 minimum to 15 maximum)
Sonde Power: Direct control of the supply of power to the sonde. Enter On or Off. This is only functional with a powered sonde. Sonde power is still manually controlled during the YSI 610 Logging mode.
Shutoff Time: Number of minutes until YSI 610 shuts itself off to save batteries. Enter 1-12, or 0 to disable shutoff. Note the YSI 610 never shuts itself off in Capture, Logging or Calibration modes regardless of the shutoff time setting.
Key Click: Enter On or Off to engage the keyboard clicking.
Year digits: Choose between a 2- or 4-digit year format
Date Format: Enter MDY or DMY or YMD.
Date Separate: Delimiter character for date display, typically a front slash (/)
Time Separate: Delimiter character for time display, typically a colon (**:**)
Radix Mark: Also known as decimal point
Date: Enter today's date in the format you selected above. You may use any delimiters you wish (Space is easiest).
Time: Enter the present time. Use any delimiters you wish. Note the time you see is frozen the moment you enter this menu.
Dump YSI 610 Setup: Sends all setup, logging, store/recall, file, etc.
Delete All Files: Deletes all files in the YSI 610.
Setup Site List: Access to Site List menu.

3.7.3 COMMUNICATIONS

TERMINAL

Select Communications from the YSI 610 Main menu. This allows you to receive files from field recoding equipment (loggers), and later send the files to a PC. Two industry standard file transfer protocols are provided, Kermit and Xmodem.

The YSI 610 can emulate a "dumb" RS-232 terminal, allowing you to configure and operate devices that communicate using ASCII characters. No handshaking lines are used in the YSI 610 Terminal Emulator. Select **Terminal** from the YSI 610-D Main menu, or from the YSI 610 –DM Communications menu.

You should be familiar with the terminal interface of the target device, or have its operations manual handy. This will avoid accidental disruption of the device's operation.

The Terminal emulator maintains an 80 character wide by 25 line image from the target device. The cursor is always on the bottom line of this image. The Arrow keys are used to pan left and right, and to back-scroll to lines that have scrolled off the screen. Panning and scrolling are indicated on the top line of the screen.

A special interpreter has also been embedded into the Terminal Emulator. The interpreter traps raw data from YSI's type 1029/1144/1152 Water Level Series products, and displays the data in engineering units. The interpreter also swallows all ANSI escape sequences to avoid cluttering the screen.

In addition, two other keys have special use in the Terminal Emulator. The **Ins** keys sends an ASCII Escape character to the target device, and the **Skip** key pans/scrolls the screen directly to the cursor position.

SMART TERMINAL

The YSI 610 provides a Smart Terminal feature that allows convenient access to the sondes advanced features. All sondes except the 6000UPG have this capability. The Smart Terminal allows the menus that are built into the sonde to flow out through the YSI 610 screen. The menu name, messages, all items on the menu, and any data being displayed all come directly from the sonde. Sometimes, however, the YSI 610 abbreviates text from the sonde so that it will fit on the YSI 610 screen.

There are several ways to get into Smart Terminal mode. The direct way is from the Communications menu, highlight **Smart Terminal** and press **Enter**. The YSI 610 also enters Smart Terminal automatically when you enter Setup Sensors, Setup Parameters, Calibration or the Deploy menus. The YSI 610 indicates that it is in Smart Terminal mode by showing the menu name (top left corner of the screen) in narrow font.

When you display data in the Smart Terminal mode, you can not Capture, Add or Store the readings.

DATA TRANSFER

Kermit 610 →PC:	To transfer files from the YSI 610 to a PC, see **Section 3.5.2**.
Kermit 610 ←Sonde:	To receive a file from a 6000UPG, 6920, 6600 or 600XLM sonde to the YSI 610, see **Section 3.5.1, Files**.
Kermit 610 ← logger:	To send a file from non-YSI equipment to a PC, see **Section 3.5, Files.**
Xmodem ←logger:	Receiving files from non-YSI equipment requires an extra step. You must first tell the equipment to begin sending the file. Do this using the YSI 610 Terminal emulator. Once the logger is trying to send the file, back out of the Terminal emulator and select **Xmodem ←logger:** or **Kermit 610 ← logger:**.

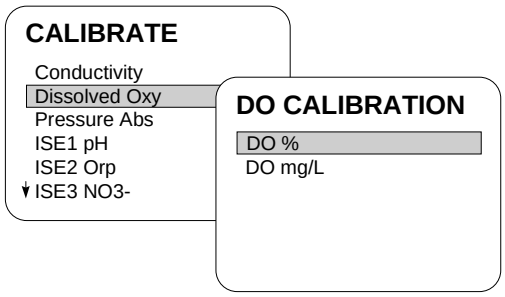
Sending non-YSI files to a PC can either be done by using EcoWatch and Kermit as discussed above, or using other PC communications software.

If you are using other PC communications software, you must first tell it to begin receiving the file. Once the other software is waiting for the file, select "**Kermit 610 → PC:**" or **Xmodem 610 → PC**, select the file to send and press Enter.

If file transfer repeatedly fails, there is probably a baud rate or cabling problem. Set the baud rate for the YSI 610 in the System Setup menu. 9600 baud is typical for YSI sondes, and YSI PC software. Set the baud rate and Com port in the Setup menu of EcoWatch for Windows. Also check the cabling. A Null Modem cable/adapter (provided) must be used when connecting a YSI 610 to a PC, because both devices are computers. A Null Modem cable must not be used when connecting the YSI 610 to a YSI sonde.

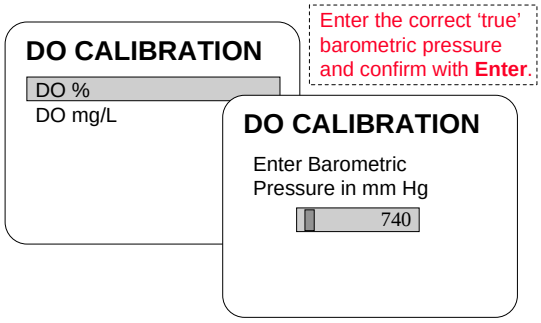
3.7.4 CALIBRATION MODE

Most sensors need to be calibrated occasionally. When you calibrate a sensor, you are telling the sonde that you know the exact value for what it is measuring. For example, you may know the exact pH of a solution in which the probe is immersed.



Keep in mind that although you are interfacing with the YSI 610, it is the sonde that is being calibrated and the results of that calibration are stored in the sonde.

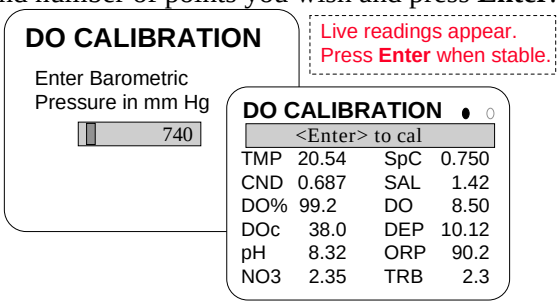
All calibrations are similar. An example of DO calibration is shown here and below. When you enter the Calibration menu (from the Main menu), you are presented a list of sensors that can be calibrated.



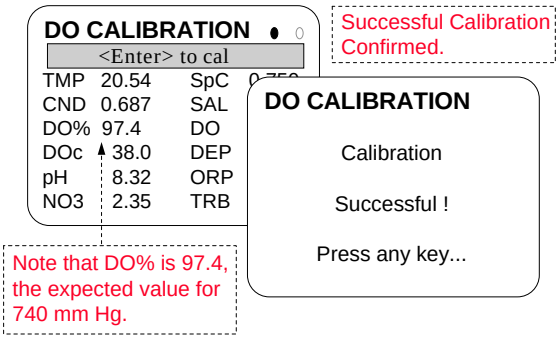
Some sensors, like pH or nitrate, can be calibrated using 1, 2, or 3 points. These options are either shown separately on the list, or offered right after you select a sensor. Select the sensor and number of points you wish and press **Enter**.

The YSI 610 requests the exact value to calibrate, and commands the sonde to calibrate.

The YSI 610 will step you through multi-point calibrations if applicable.



All YSI sondes described in this manual display the reading until you are satisfied that it is stable.



Errors can occur during calibration. The number you enter may be out of range, the sensor may be installed incorrectly or the sensor may be drifting. If an error occurs, the sonde rejects the calibration and an error message is displayed on the YSI 610 screen. Some types of errors can be overridden and the display then offers you an option to accept. Never override an error or warning message without understanding the problem and being certain that your data will not be compromised.

When calibrating turbidity or chlorophyll, it is important to eliminate bubbles that can drastically alter results. The 6026 Turbidity Probe and the 6025 Chlorophyll Probe have a wiper that is very helpful in removing bubbles during calibration and reading. You can activate the wiper manually by pressing the T key, at any time while you wait for stabilization.

Before a calibration is complete, you may press **Esc** to abort it.

3.7.5 SETUP PARAMETERS AND SETUP SENSORS

These two menu choices allow you to display or change the active sensors and parameters in the sonde. They are entered through the YSI 610 Main menu or through the Deploy menu into Sensors (Setup Sensors) and Report (Setup Parameters). See **Section 2.9, Sonde Menu**.

3.7.6 DEPLOY MODE

The Deploy menu takes you right into the Run /Unattended menu of the sonde. For more see **Section 2.9, Sonde Menu.**

3.7.7 LOGGING MODE (YSI 610 DM ONLY)

The YSI 610-DM can log sample data to its internal memory from any YSI sonde. This is separate from the sonde's ability to log data into its own memory. Logging produces a file in the standard file format, capable of being uploaded to a PC and processed by EcoWatch for Windows. See **Section 3.4, Logging** for a detailed explanation.

Select Logging from the YSI 610-DM Main menu. Then select Setup Header. This menu allows you to specify control and timing information for the deployment.

File: The YSI 610 file name to log data into.
Site: The Site name to embed in the file
StDate: Date to start logging (use "now" if you wish)
StTime: Time to start logging (use "now" if you wish)
Duration: Length of deployment (see **Section 3.7.5** for how to properly enter duration)

Interval: Recording interval (see **Section 3.7.5** for how to properly enter interval)
WarmupTime: Warm up time for the sondes DO sensor (seconds)

Press **Esc** to go back to the Logging menu, then select **Setup Filter**. The Setup Filter menu allows you to automatically discard samples that do not meet your criteria.

Log All Points:	Press **Enter** here to record all samples taken.
Wet Switch:	Press **Enter** here to record only those samples taken when the probe is wet. This only logs sample with a conductivity greater than 180 uS/cm
Log Only When:	Press **Enter** to activate the next three menu items.
Param:	Press **Enter** to select a parameter for comparison (selected from a list)
Is:	enter Above to record samples above the value, or below
Value:	Enter a value in appropriate engineering units for comparison.

The **Start YSI 610 Logging** menu begins the logging session that was specified in the Setup Header and Setup Filter menus. If the file name specified already exists and was created by Logging on the YSI 610, new data will be appended to the file. If the file name does not exist, you will be asked if you want to create it, asked to enter a site name, and asked if you want to enter the weather info. Pressing the **Esc** or **Power** keys terminates logging. Logging stores all parameters to the data file even though only 12 fit on the screen.

The **Logging** screen tells you how much space is available for additional logging, and how much time this corresponds to in Logging mode.

If the sonde is equipped with a wiping turbidity probe, the probe will be cleaned automatically before each sample but only if time permits. Cleaning takes up to 40 seconds, and the YSI 610-DM makes sure that cleaning will end at least 30 seconds before the sample. You set the number of wipes in the Sonde main menu, see **Section 2.9, Sonde menu.** When the YSI 610 is started, the number of wipes is included in the information screen. This allows you to verify that wiping will occur.

3.7.8 FILE SYSTEM (610 DM ONLY)

The YSI 610-DM is equipped with 96 K bytes of battery-backed RAM to hold data files. Files can be created in the YSI 610 itself (by using Logging, Capture or Add) or can be transferred from a YSI or non-YSI logger (by Kermit or Xmodem). The YSI 610 can hold up to 50 files. See **Section 3.5, Files** for a detailed explanation of how to use the File system.

The YSI 610 provides flexible access to the files. You can view them at any time in any order. You can append data to them in any order (provided you are appending data in the same manner it was originally placed in the file). You can append data to one file, then another file, then return and append data to the first file again. The only limit on file size is the amount of unused memory. Deleting a file immediately frees up its memory to use for other files.

To access the file system, select **610 File System** from the YSI 610-DM Main menu. The Files list appears with a file size next to each name. File names are always unique and are case-insensitive. At the bottom of the Files list is a note about how much RAM is free. Select the file

that you want to access, and press Enter. The Files sub-menu appears. If the YSI 610 only holds one file, the software skips the Files list and proceeds directly to the File sub-menu.

The View Header menu provides you a summary of administrative information about the selected file. If the file was uploaded from a non-YSI logger, the summary is not shown. Instead a text viewer is activated, allowing you to view a flat ASCII text file using the four Arrow keys and the 0-9 keys (0 moves to the start of the file, 9 to the end of the file, 1-8 part-way through the file).

Origin:	Where the sonde came from
Device:	What sonde the data came from
Site:	The site name embedded in the file
ID:	The serial number in the file
ROM:	Program version of the YSI 610 (or Sonde for uploaded files)
Samples:	Number of data records in the file
Datums:	Number of datum/calibration records in the file
Began:	Date and time logging was started
First:	Data and time first sample was taken
Last:	Data and time last sample was taken
Interval:	Recording interval when file was created
Length:	Length of file (in days or hours)
Params:	Complete list of parameters in file

The View Data menu allows you to view all the data in the selected file. Data is arranged into labeled columns. Day-of-the-month and time are always the leftmost columns. Use the four Arrow keys to view the data. Additionally, the 0-9 keys help you quickly position yourself in large files: 0 moves to start of file, 9 to end of file, 1-8 part way through file.

If the file is uploaded form a non-YSI logger, the data is shown using a text viewer instead. The text viewer allows you to view a flat ASCII text file using the four Arrow keys and the 0-9 keys.

To conserve memory, files uploaded from YSI sondes only contain measured data. Only measured data is seen on the YSI 610, but when the file is uploaded into EcoWatch all data and derived calculations will be available as usual.

3.8 TECHNICAL INFORMATION

3.8.1 SOFTWARE UPDATES

YSI 610 software may be updated from time to time. This is simple since the 610 uses non-volatile FLASH memory to hold the software. New 610 software can be installed by using a PC. To update software all you need is a YSI 610 software update diskette from YSI. Everything else you need comes with the standard 610 kit.

The 610 software update diskette contains two files used for update, and may contain other files. The two files are AOUT.A03 that contains the new 610 software, and LOAD4.EXE which is a PC program you run to send the new 610 software to the 610.

When loading new 610 software, the entire keyboard will appear to work incorrectly. This is normal. Follow the instructions below carefully. If you type a wrong character, hit the Skip key (which is a backspace).

3.8.2 LOADING NEW SOFTWARE

To load new YSI software into the 610, proceed carefully as follows:

1. Connect the 610 to a Personal Computer in the MS-DOS mode, using the Null Modem cable (provided). This forms a 5-wire RS-232 connection. You must use the COM1 RS-232 port of the PC.

2. Make sure there is no mouse on COM1 or COM3.

3. Set the PC to run from the floppy drive which holds the YSI programs (type A: or B: on the PC, and press **Enter** on the PC).

4. Disconnect the wall charger from the 610 if it is connected.

5. Turn off the 610 by pressing Power, or by pressing Esc then Power. Reset the 610 by tapping the Esc and Skip keys simultaneously, and then releasing them immediately. If you did this correctly the message RESET DONE or MASTER RESET will appear in the 610 display. If you do not get either message, go back to step 5.

6. Type the following 5 keys on the 610: D C ? Del Bksp. Verify you see PMODE on the 610 screen. If you make a typo, press Skip to backspace over the typo and retype it. Once you see PMODE press the Z key. The 610 screen displays PROGRAMMING MODE !!LOADING!!

7. On the PC at the DOS prompt, type the command "LOAD4 -ROM -F128" and press Enter (also on the PC). This runs the transfer program. Loading begins at once and takes about 5 minutes. Loading is complete when the DOS prompt returns to the PC screen, and you hear a chirp from the 610.

8. Verify the message ALL ROM BANKS SENT is on the PC screen, and the word COMPLETE has appeared on the 610 screen. If either message is not shown, go back to step 1.

9. If the 610 has never been loaded with YSI software before, you need to do items A-E below. These items are shown here for completeness. Otherwise proceed to step 10.

10. (A) Type the 5 keys: ' Bksp _ G D. Verify you see SETUP on the 610 screen. Press the Z key.
    (B) Press Q until baud rate is 9600, then press "
    (C) Press Q until word format is 8D+1 STOP then press "
    (D) If bank number is not 0, press Q Y Z then press "
    (E) If prog addr is not 16384, press Q S P U J N Z then press "

11. Type the following 3 keys on the 610: F G ". Verify you see RUN on the 610 screen. If you make a typo, press Skip to backspace over the typo and retype it. Once you see RUN press the Z key. The 610 displays YSI SOFTWARE INITIALIZED for 3 seconds, then shuts itself off.

12. The 610 is now ready for use.

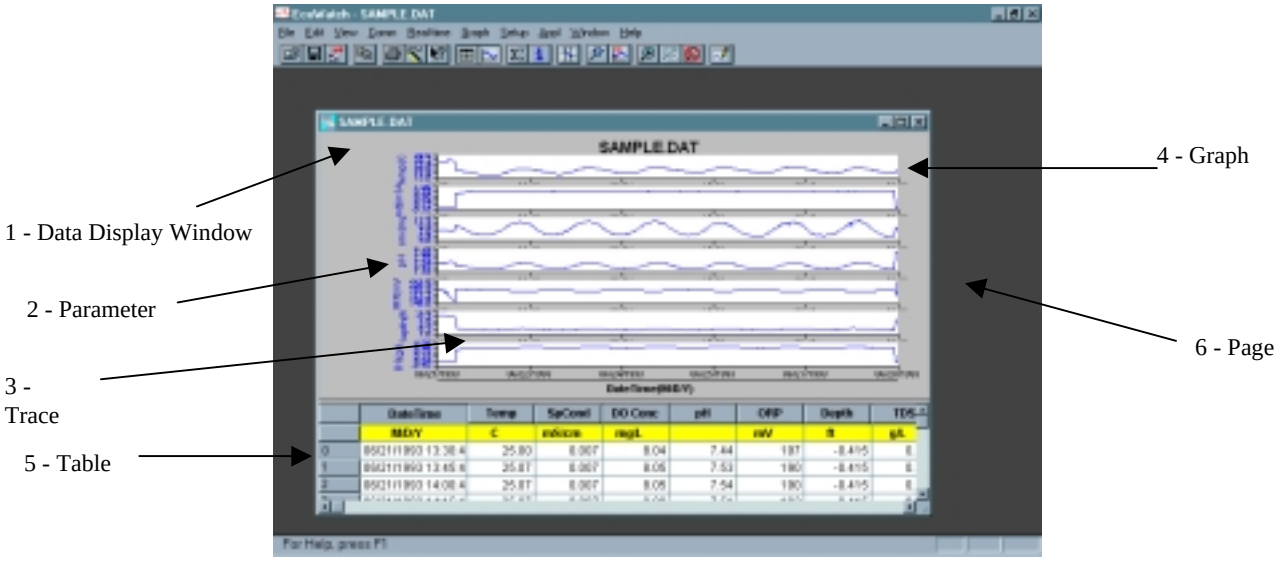
SECTION 4 ECOWATCH FOR WINDOWS

4.1 INTRODUCTION

EcoWatch for Windows is intended to be the PC software interface to YSI's 6-Series environmental monitoring systems equipment. From EcoWatch you can program field equipment, upload data collected on the equipment, and format the data in easy to understand graphs and tables.

4.1.2 GLOSSARY

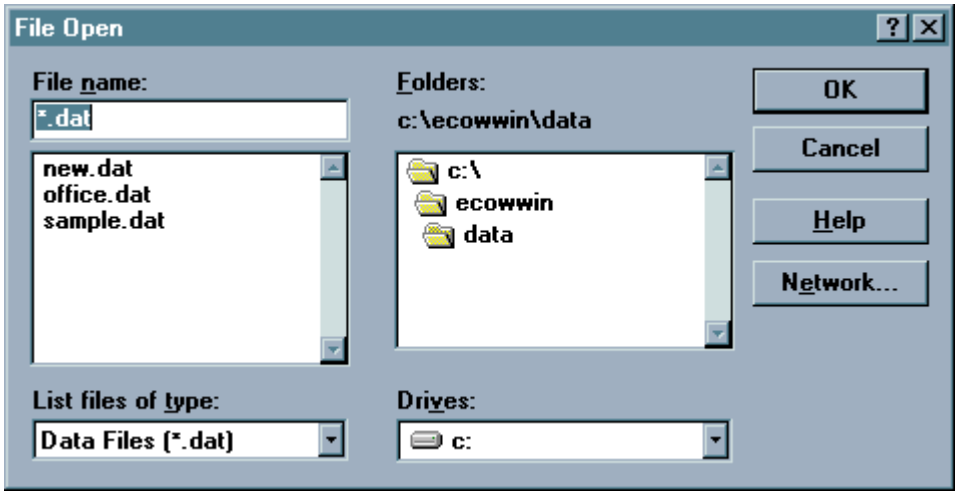
These are a few of the more commonly used terms used in EcoWatch.



Term	Definition
1 - Data display window	The window that appears when you open a .DAT file.
2 - Parameter	A measurement such as temperature, dissolved oxygen, pH, etc. On a graph, the data of a parameter is displayed as a trace.
3 - Trace	The plot of the data of any one parameter. There may be one or two traces per graph.
4 - Graph	There may be one or more graphs depending upon how many parameters are selected. Each graph may have

	one or two traces. Data can be displayed either in graphs or in a table, or both.
5 - Table	Numbers arranged in rows and columns. Data can be displayed either in graphs or in a table, or both.
6 - Page	The Data Display Window can be divided in two pages, a graph page and a table page. A page becomes active when you click on it.
7 - Terminal window	This is the window that is open to display the sonde's internal menu. Allows the user to interact with the sonde or display/logger. The terminal window is a communication interface with another piece of equipment, whereas the Data Display Window is direct interaction with the EcoWatch software.

8 - Dialog box	A dialog box opens to display choices. Such as File Open.



9 – PC6000 data file	A data file that is in a format compatible with EcoWatch for Windows or PC6000 software.
9 – Study	A single data file in PC6000 format.

4.1.3 TUTORIAL

This brief EcoWatch tutorial is to be used with the sample data file that is provided with EcoWatch.

EcoWatch starts without an open data file (or .DAT file). When a data file is not open, a shortened menu bar is visible and many of the tools in the toolbar appear dimmed. Opening a data file will better demonstrate the capabilities of EcoWatch software.

To open the sample data file:

1. Click the **File** menu  button in the toolbar.
2. Select the **SAMPLE.DAT** file.
3. Click **OK** to open the file.

Note that the data in this file appears as a graph of temperature, specific conductance, dissolved oxygen, pH, ORP, and depth, all versus time. The graphs are scaled automatically so that all data fits comfortably on the computer screen.

The **Table**  and **Graph**  buttons on the toolbar are on/off switches that are used to display or hide the graph and table pages respectively. When displaying a graph and a table at the same time, you can control the relative size of the two pages by placing the cursor over the small bar that separates them and then dragging it to the desired location.

From the **Setup** menu, click **Graph**. Click **2 Traces per Graph** and notice that the parameters are now graphed in pairs. Click **1 Trace per Graph** to return the display to the original setting. Move the cursor to any position in the graph, then click and hold the right mouse button. Note that the exact measurements for this point in time are displayed to the left of the graph. While holding down the right mouse button, move to another area on the graph. Notice how the measurements change as you move. When you release the mouse button, the display returns to normal.

To view statistical information for the study, click the **Statistics**  button on the toolbar. On the statistics window, click on any min or max value to display the time when it occurred. Double-click in the upper left of the Statistics window to return to the normal display.

End the tutorial by saving the Data Display in the format shown. To do this:

1. From the **File** menu, click **Save Data Display**.
2. Type Default for the file name when prompted for the Data Display Name.
3. Click **Save**.

The parameters, colors, format, and x-axis time interval associated with the current display are now saved and can be accessed any time in the future. Nine different data displays may be saved for any data file. You can easily switch between various displays of the data.

This demonstration shows only a small part of the capability of EcoWatch. You may wish to also review the procedures involved in the **Section 4.1.5**, **Typical Application**.

4.1.4 USING THE TOOLBAR

The EcoWatch toolbar includes buttons for some of the most common commands in EcoWatch, such as **File Open**. To display or hide the toolbar, open the **View** menu and click on the **Toolbar** command. A check mark appears next to the menu item when the toolbar is displayed. The toolbar is displayed across the top of the application window, below the menu bar.

Click To:

Open an existing data file (.DAT). EcoWatch displays the **Open** dialog box, in which you can locate and open the desired file.

Save the working Data Display of the active data file. EcoWatch displays the **Save Data Display** dialog box in which you can overwrite existing Data Display or save to a new one.

Export data as a graph in Window Meta File (.WMF) format or as data in Comma Delimited (.CDF) format.

Copy the whole graph page or data from the selection on the table to the clipboard.

Print the active graph page or table page depending on which one is currently active.

Open a new terminal window to communicate with the sonde.

Access context sensitive help (Shift+F1).

Toggle table window during file processing.

Toggle graph window during file processing.

Display study statistics.

 Display study info.

 Limit the data to be processed in a study.

 Enlarge a selective portion of graph.

 Center the graph under the cursor.

 Enlarge graph or table 20%.

 Reduce graph or table 20%.

 Return graph or table to its normal state (unzoom)

 Redraw the graph.

4.1.5 TYPICAL APPLICATION

Suppose you want to measure Dissolved Oxygen, pH, Temperature, and Turbidity in a nearby stream and decide to start with a 30-day deployment using the YSI 6920 sonde. The task can be organized into several steps:

1. Calibrate and setup the sonde.

First connect your sonde to one of the serial communications ports on your PC. In the **Comm** menu, click **Sonde** and you will get a terminal window where you can calibrate the sonde and set it up for logging. You are now communicating directly with the sonde software. See **Section 2.6, Calibration** for more detailed instructions on calibration of sensors. See **Section 2.5, Sonde Software Setup** for sonde setup.

2. Deploy the Sonde

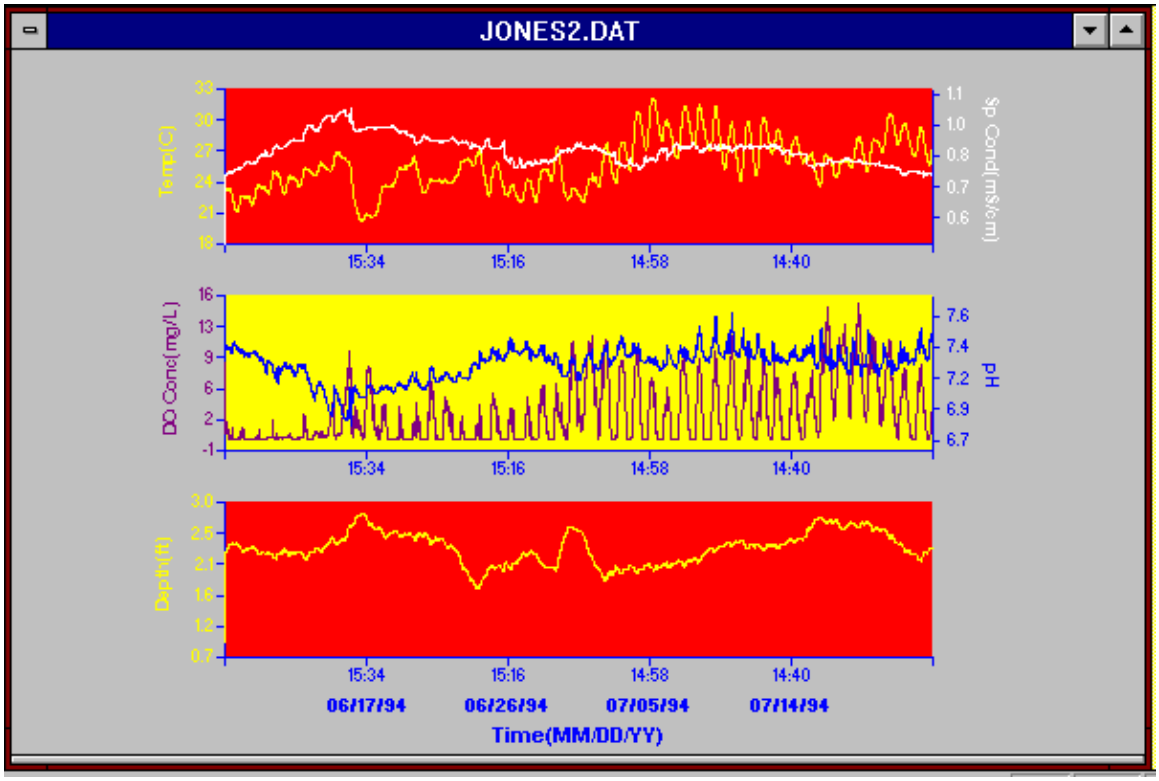
For more details, see **Section 2, Sondes and Section 3, Displays/Loggers**.

3. Retrieve the Sonde and Upload the Data

After retrieving the sonde, connect it to your PC and upload the data. As with calibration and setup, you can use the Sonde  button in EcoWatch to communicate with the sonde. Using the sonde menu, upload the data to EcoWatch. The data will now be in a .DAT file on your PC.

4. Graph the Data and Adjust the Graphs to Your Liking

Open the newly uploaded .DAT file. In this example, the file is called JONES2.DAT. Upon opening the file it looks like the graphic at the end of this tutorial. You can then use the commands in the **Graph** menu to **Zoom** to the portion of the graph that you are most interested in. You can use the **Setup** menu to add a title or change colors, scale the graphs or select the parameters to be shown.



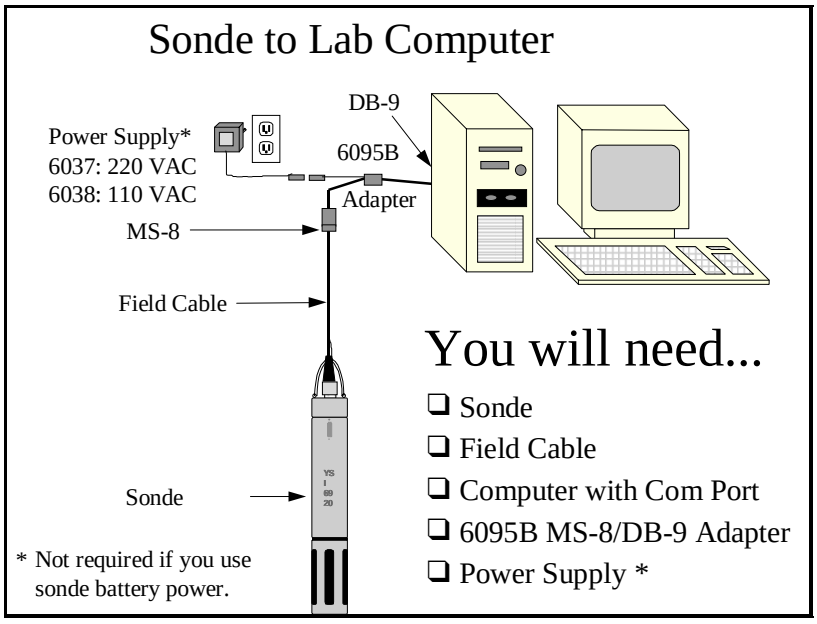
5. Print Your Graph

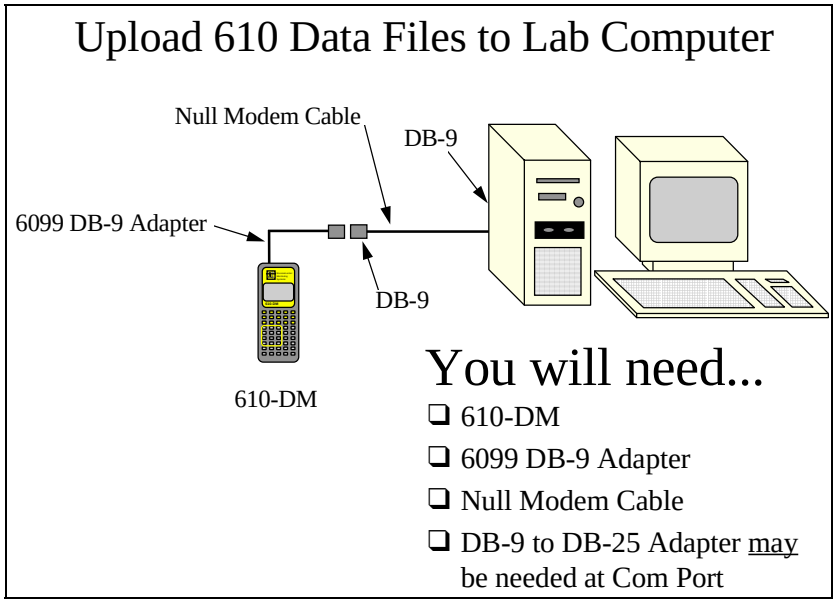
To print the graph, open the **File** menu, choose **Print Setup** or **Print** to choose exactly how the print should look.

4.2 DATA ACQUISTION AND ANALYSIS

4.2.1 CONNECT A YSI SONDE OR A 610 DISPLAY/LOGGER

EcoWatch may be used with various sondes or display/loggers. To utilize the configuration that will work best for your application, make sure that you have all of the components that are necessary.





A sonde or 610 display/logger must be connected to one of the serial communication ports on the back of your PC. These ports are usually referred to as COM1, COM2, etc. Most computers have at least two COM ports but they are often not labeled. To identify a COM port, look for unused 9 or 25 pin, D-shaped connectors with pin contacts.

Some sondes have integral cables and others require a separate cable sold especially for use with the sonde. Depending on the exact connector on your PC, you may also need a 9 to 25 pin adapter.

There is an adapter for the 610 display/loggers that has a 9 pin D-shaped connector. This connector must be attached to a null modem cable and then to your computer.

Once physically connected, you are ready to communicate using EcoWatch. Use the **Sonde** command in the **Comm** menu or the sonde button on the toolbar. This will give you a terminal window. From this window you interact with the sonde software using its menu system, or upload a file from a 610 display/logger. See **Section 2, Sondes** for details on how to use the sonde software.

4.2.2 UPLOAD A FILE FROM A SONDE

Data that is processed in EcoWatch typically originates in a sonde with batteries and is uploaded to a PC. To upload data from a YSI sonde, connect the sonde to your PC and open the EcoWatch software. Use the Sonde button on the toolbar to communicate with the sonde software.

Using the sonde software, go to the **Main menu** by typing "**menu**" on the blank terminal screen. Then choose **3-File Menu**. You will most likely be uploading the most recently recorded data. If so, simply press **3-Quick Upload**. Otherwise, press **2** to choose a file to upload. The sonde will ask you to choose a format for the file. Be sure to choose **PC6000 format**. After it is uploaded, the data will be in a **.DAT** file on your PC. You can then use EcoWatch to view, manipulate and print the data file.

4.2.3 UPLOAD A FILE FROM A 610 DM DISPLAY/LOGGER

Connect the null modem cable to the appropriate PC COM port. Connect the other end of the null modem cable to the YSI 610 DB-9 pigtail PC adapter. From the YSI 610 Main menu, select **System Setup** and verify that the Baud Rate is 9600 (or matches the PC). Change it if necessary.

Run EcoWatch for Windows software on your PC, then select **Settings** from the **Comm** menu. Verify the Baud Rate is 9600, and that the COM port is correctly assigned. Change them if needed. Select **Sonde** from the **Comm** menu and press **Enter**. A blank screen will appear.

From the YSI 610 Main menu select **Communications**, then select **Kermit YSI 610 > PC**. Select the file you wish to send, or select **Send All Files** (at the bottom of the list). If a file by the same name already exists in the PC, EcoWatch will ask you if you want to overwrite the PC file. If you do not want to overwrite, press "**N"**, and type in a different file name.

During the upload, you will see several status counters on the YSI 610 and PC screens. Any errors that occur during the upload are detected and corrected by EcoWatch. But if the counters

do not advance, click the **cancel** button on the upload progress dialog and press **Esc** at the YSI 610 to abort the upload, and try again. When the upload is complete, the status will read "**Successful**".

The data will now be in a **.DAT** file on your PC.

4.2.4 USING THE GRAPH

Once uploaded, data can be easily displayed in EcoWatch. Open a **.DAT** file. The six buttons on right side of the toolbar help you get a closer view of that portion of the graph you desire.

Zoom Window 

Use this to select a certain portion of the graph to be displayed. Click the button and then click and drag on the graph to select the portion you want to view. The pointer will change to a magnifying glass. The button will stay active until you click on it again.

Center Scroll 

Use this to scroll through the study. Click the button and the pointer will change to a bullseye. Click anywhere on the graph and that spot will move to the center.

Limit Data Set 

Use this button to reduce the data being processed and speed up operations. Click the button and move the pointer to the graph. A vertical arrow will appear with an N on the left and an Y on the right. Bracket the desired portion of the graph by moving the cursor to the left limit, clicking, moving to the right limit and clicking again. To limit the data in a table, move the pointer to the far left of the table into the row numbers area and highlight from the desired cutoff point to the beginning or end of the data set, whichever is desired. Then select the **Limit Data Set** option from the **Graph** menu or use the toolbar shortcut. To remove the limits, from the **Graph** menu choose **Cancel Limits**. You may also remove the limits using this button by clicking first on the right and then the left.

Unzoom 

Use this button to view the study from the beginning limit to the end limit. This command can be used on both graphs and data tables.

Zoom In 

Click this button to magnify by 20%. This command can be used on both graphs and data tables.

Zoom Out 

Click this button to reduce magnification by 20%. This command can be used on both graphs and data tables.

4.2.5 GRAPH DATA IN REAL TIME

Choosing the **New** command from the **Real-time** menu will bring up a window with graphs that plot data from the sonde as the measurements are being taken. If you do not have a default COM port set in the **Communications Settings** dialog, then you will be asked which COM port to use for the real-time measurements. If you do have a default port selected, then the program will use that port automatically.

The number of parameters displayed during real-time is set by the sonde. If four parameters are set in the Report setup in the sonde, then those same parameters will be displayed in real-time. If you want to change the parameters displayed, then you must close the real-time window, open a sonde terminal window, change the number of parameters in the sonde software menu, and then return to real-time measurements.

The **Settings** command in the **Real-time** menu takes you to a dialog where you can set the x-axis time and the sample interval.

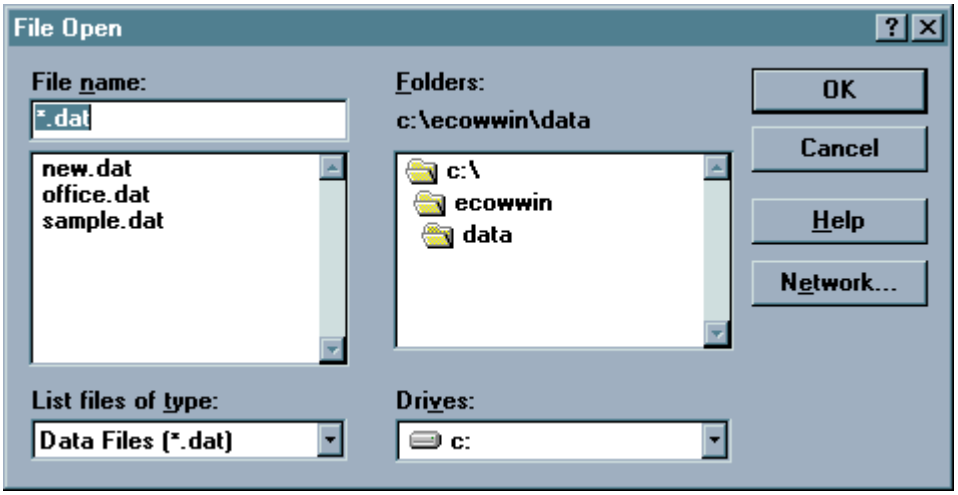
4.3 ECOWATCH MENU

4.3.1 FILE

The **File** menu offers the following list of commands. Some commands are available only when a file is open.

OPEN

Use this to open sonde data file (.DAT).



File Name Type or select the filename you want to open. This box lists files with the extensions you select in the **List Files of Type** box.

List of Files of Type Select the type of file that you want to open.

*.dat	Sonde binary data file
*.txt, *prn	ASCII text file
*.cdf, .csv, .sdf	Comma delimited file
*.rt	Real-time file
*.cr1	CR10 file

Drives Select the drive where the PC6000 data file resides.

Directories Select the directory where the PC6000 data file resides.

Network... Choose this button to connect to a network location, assigning it a new drive letter. This button is hidden if your computer is not connected to a network. The screen above has the network button hidden.

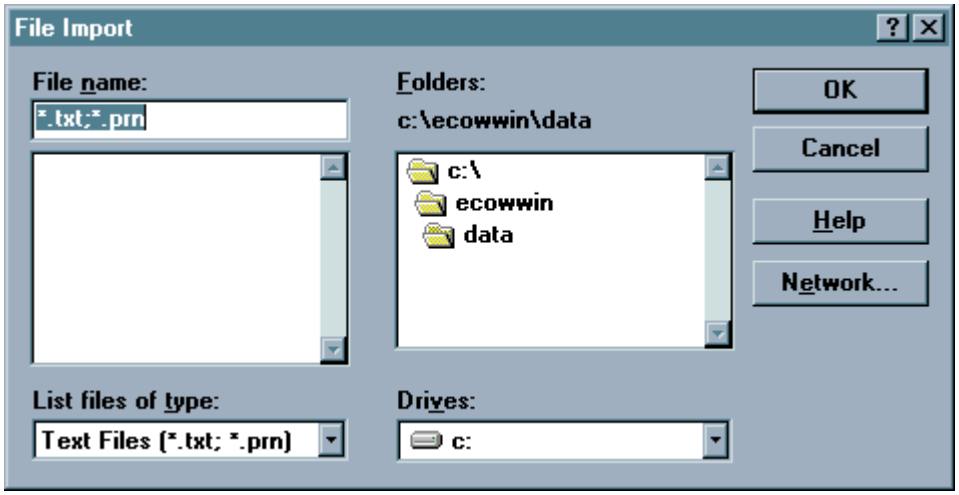
CLOSE

Use this command to close all windows containing the active document. EcoWatch automatically saves any changes before the file is closed.

You can also close a document by using the **Close** icon on the document's window, as shown below:

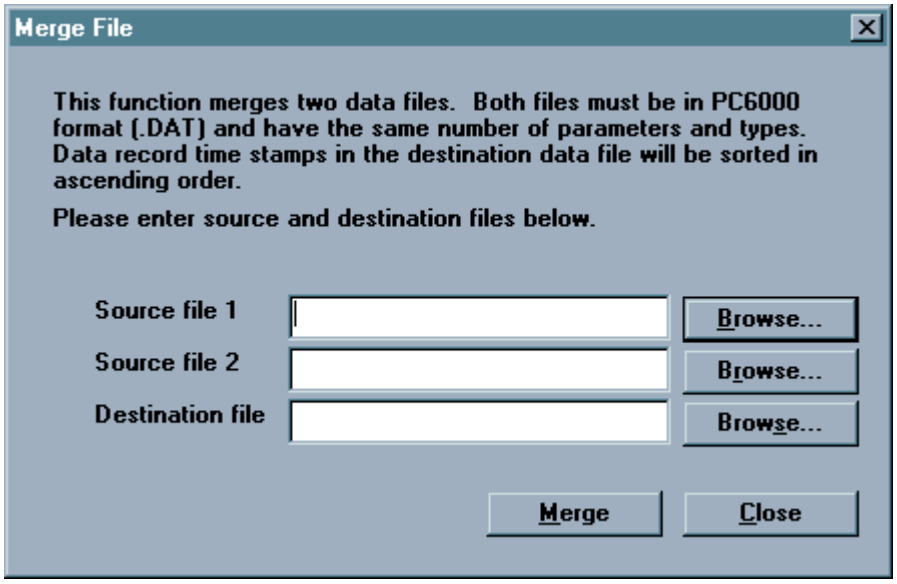
IMPORT

With this command, you can import common ASCII files into EcoWatch. The file will be converted into PC6000 format and again with a .DAT extension.



MERGE

This function takes two existing data files and merges them into one new file. Both files must be in PC6000 format (.DAT), have the same number of parameters, and the same parameter types (the parameter setup must be identical). Data record time-stamps in the destination data file will be stored in ascending order.



COPY TO CLIPBOARD

If a graph or table is active, then choosing this command will send its contents to the Windows clipboard so that it can be pasted into other programs. This is a normal method of transfer data between different Windows programs.

Shortcuts

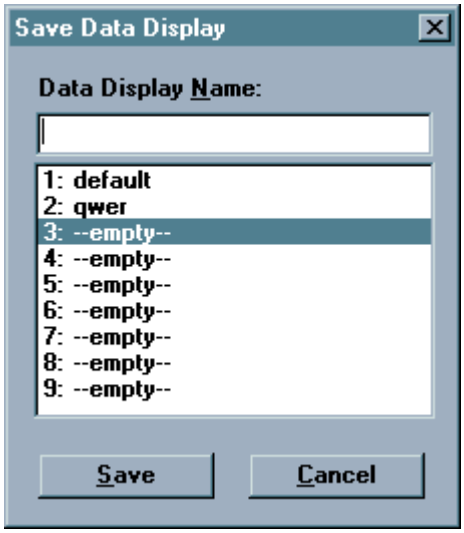
Toolbar: 

Keys: CTRL+C

SAVE DATA DISPLAY

When opening a data file, you will probably want to look at the data in graph form. You may also want to rearrange the default graph by selecting or reordering parameters, zooming in to a portion of the graph, or even changing colors or changing fonts. You may sometimes choose to look at the data or a portion of it in table form. All of this work is done in the Data Display window.

This command allows you to save the settings and content of the Data Display window so that you can load it at another time and have it look exactly the same as when you saved it. This saved display is associated with the data file. Up to 9 data displays can be saved per data file. When you save a display you will be asked to give it a name in the following dialog box.

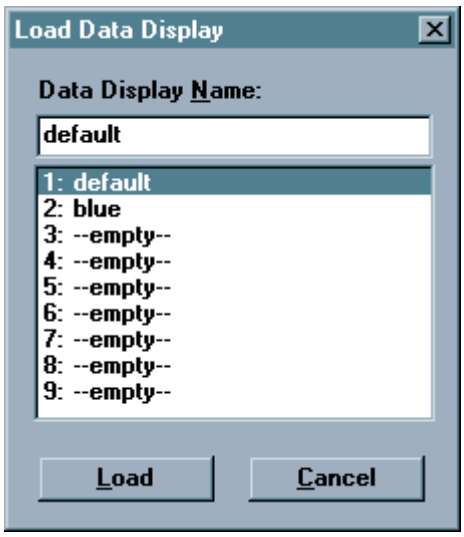


There must be an open data file for this command to be available. See also **Load Data Display.**

Shortcuts
Keys: CTRL+S

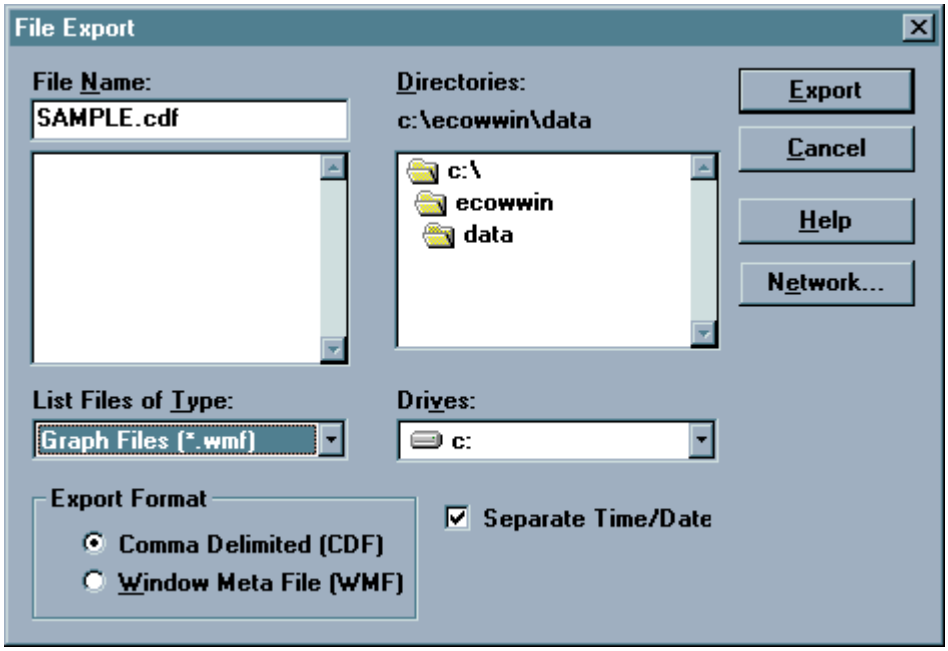
LOAD DATA DISPLAY

This command is only available when a data file is open. If you have previously used the **Save Data Display** command for the open data file, then you can load the saved display and have it look exactly the same as when you saved it. Saved displays are associated with the data file. You can have as many as nine saved displays for each data file. When loading a display you will be asked to choose from among the names of saved displays.



EXPORT

Use this command to send the current data to a file. Typically, some other program will read the file. You will see the following dialog box.



You may export the file in either of two forms: a WMF file, or a .CDF file.

WMF stands for Windows MetaFile and is a format that describes any image in a way that is independent of the program that generated the image. For example, you can generate a graph in EcoWatch, export it as a .WMF file and then import it into another Windows program.

CDF stands for Comma Delimited, sometimes referred to as a Comma and Quote Delimited File. This format is commonly used by spreadsheet and database programs. In this type of file, commas separate individual data entries, quotation marks surround any text and no formatting or marking is performed on numbers. EcoWatch can also open files in CDF formats.

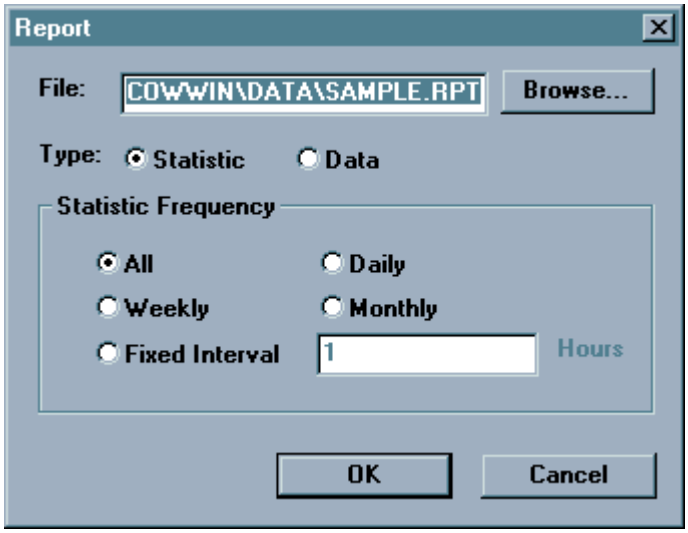
When the exported file is to be imported into a spreadsheet, it is sometimes convenient to reduce the number of data. Averaging them can easily do this. See **Change Parameter Attributes** for more information.

Shortcuts

Toolbar: 

REPORT

Use this command to send data or statistics to an ASCII text file. The information is easy to read in this format. When choosing this command the following dialog box will appear.



- You must enter a filename (under **File**; use the **Browse** button if needed). If you want to simply have a report **Type** listing the data, then click **Data**. If you want **Statistics** (minimum, maximum, average, and standard deviation), then the statistics frequency button applies.

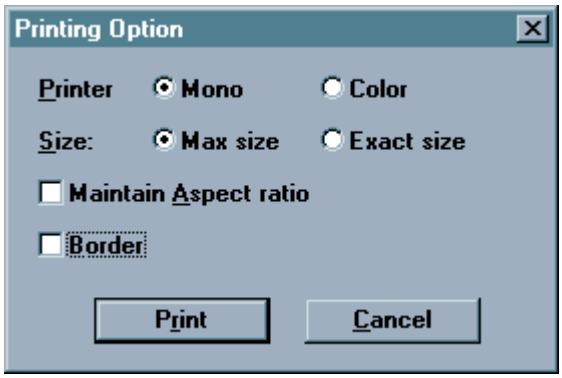
- If you want to have **Daily** statistics, keep in mind that every day actually starts at midnight. It would be likely then that the first and last days would have very different statistics because they would only be partial days. **Daily, Weekly** and **Monthly** statistics behave similarly.

- When you click **OK**, EcoWatch will send the report to the specified file and open **Windows Notepad** where you can view and/or print the report. Note: Notepad can only open report files that are 64K or less in size. You can use the Windows

Wordpad to open reports that are larger than 64K. Unless you change it, the report file will have the same location as your data file (.DAT) and has the same name with a .RPT file extension.

PRINT

Use this command to print a document. If a graph is selected, this command presents a **Print Option** dialog box with the options below. When a table is selected, a standard print window is presented.



Shortcut

Toolbar: 
Keys: CTRL + P

Printer
If you have a color printer, you can choose to print in **Color**. Otherwise you should choose **Mono** (black and white).

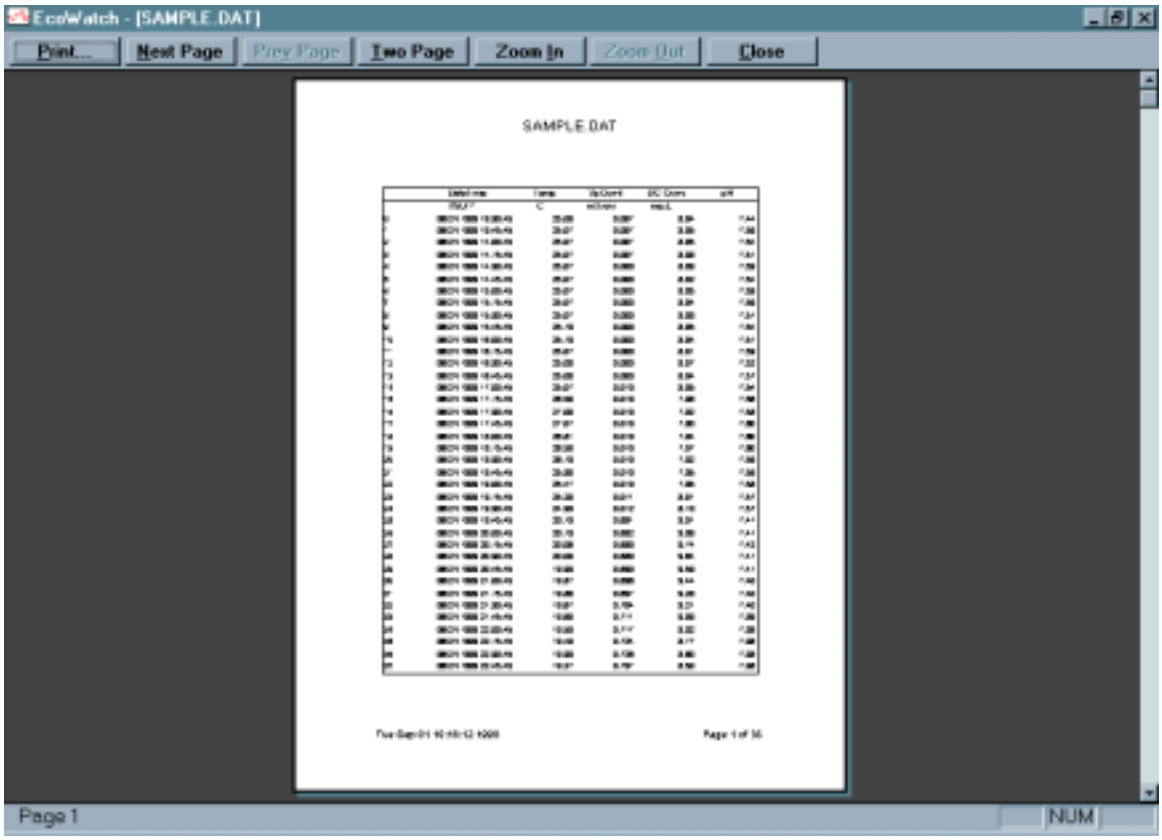
Size
If you choose **Max** size, then the program will size the graph so that it fits on one page. If you choose **Exact** size, then program will print the graph as close as possible to the size that is displayed.

Maintain Aspect Ratio
If you choose to maintain the aspect ratio, then the program will size the graph until either the height or the width is maximized and then leave the graph in the same height width ratio that is displayed.

Border
You can also choose whether or not to print a border.

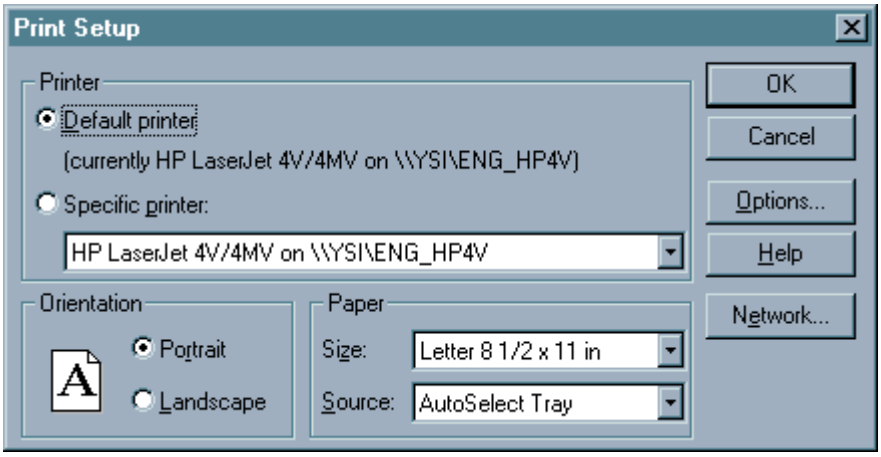
PRINT PREVIEW

This command allows the user to preview how the document will appear when it is printed. This command only works for data that is displayed in a table format, not when the data is in graph format.



PRINT SETUP

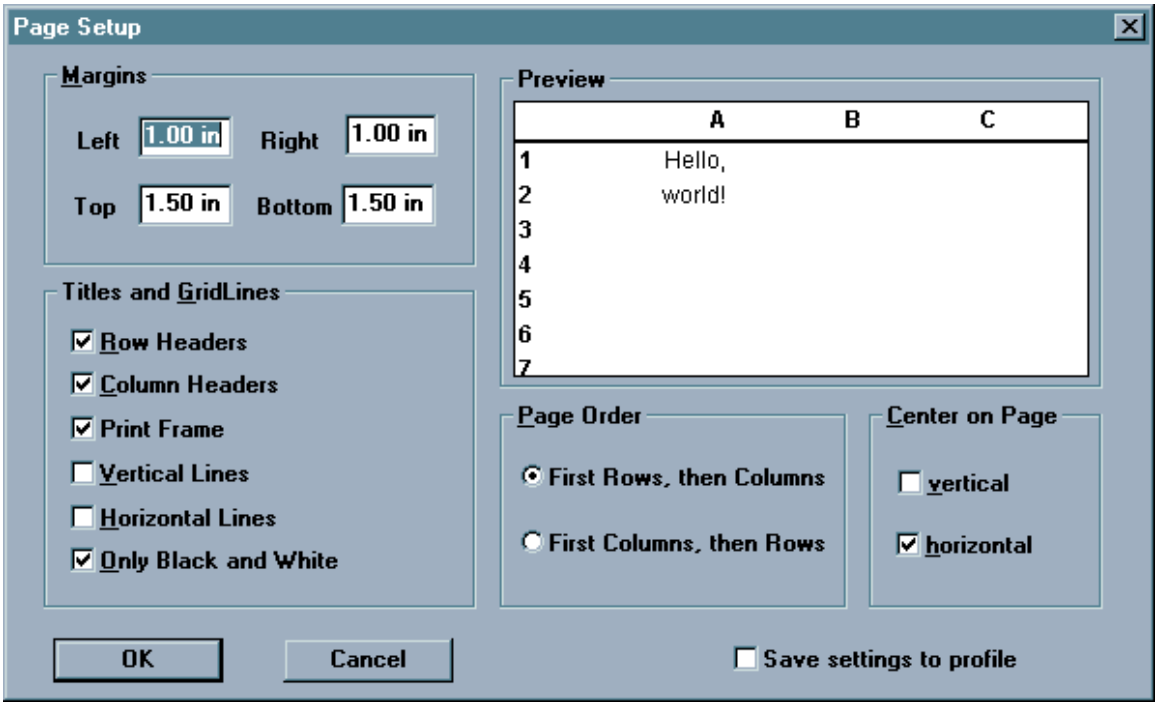
Use this command to select a printer and a printer connection. This command presents the **Print Setup** dialog box. The following options allow you to select the destination printer and its connection.



Printer	Select the printer you want to use. Choose the **Default Printer**; or choose the **Specific Printer** option and select one of the current installed printers shown in the box. You install printers and configure ports using the Windows Control Panel.
Orientation	Choose **Portrait** or **Landscape**.
Paper Size	Select the size of paper that the document is to be printed on.
Paper Source	Some printers offer multiple trays for different paper sources. Specify the tray here.
Options	Displays a dialog box where you can make additional choices about printing, specific to the type of printer you have selected.
Network	Displays a dialog box that allows you to choose a printer if you are on a network.

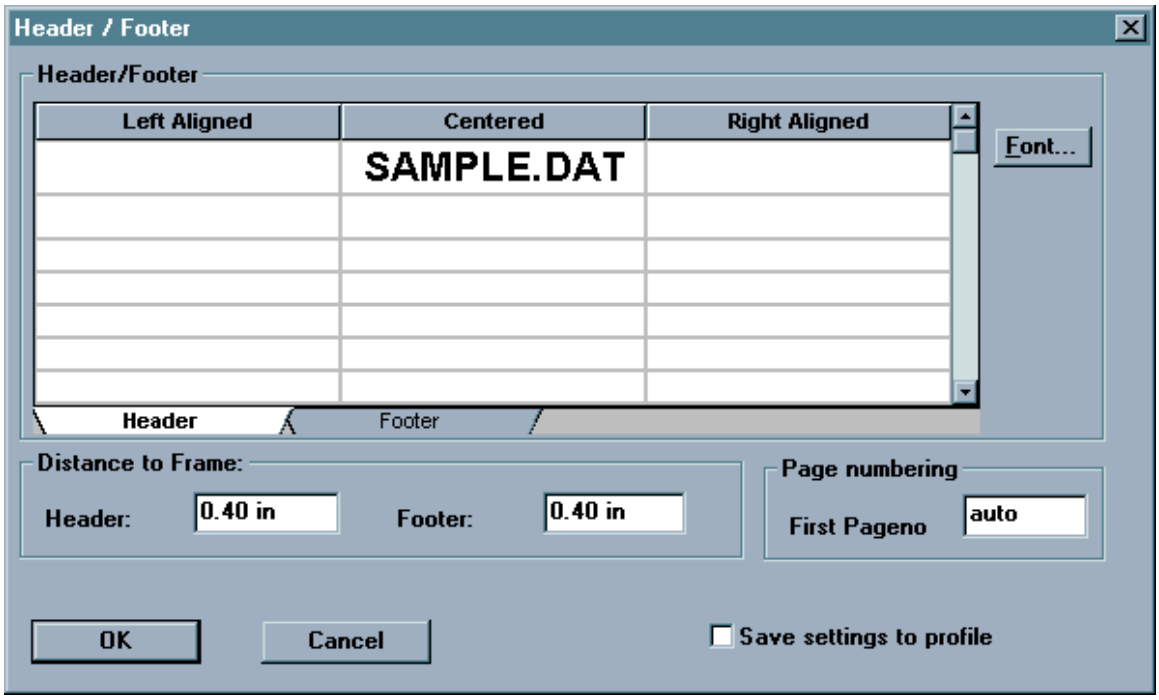
PAGE SETUP

Layout options for printable data tables may be specified. Page margins, table setup, page orientation, and page order are adjustable.



HEADER/FOOTER

Page headers and footers can be customized with respect to font and placement. Both the header and footer have separate tabs as shown below. Once the desired profile is created, it can be saved for use every time the particular data file is opened.



4.3.2 EDIT

The edit menu appears whenever a data file is opened in EcoWatch. It allows you to locate, format, and manage data.

COPY

Copies the selection to the clipboard. If a graph or table is active, then choosing this command will send its contents to the Windows clipboard so that it can be pasted into other programs. This is a normal method of transfer data between different Window programs.

Copying data to the clipboard replaces the contents previously stored there.

Shortcuts

Toolbar: 
Keys: CTRL+C

PASTE

This command does not function in this version of EcoWatch.

REMOVE PARAMETERS

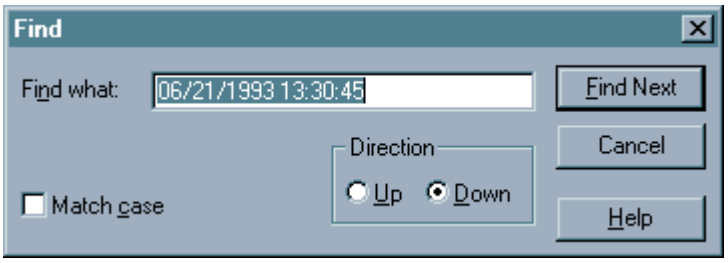
When entire column(s) of data is selected, including the heading(s), this command will remove the parameter(s) from both the data table and graph.

INSERT PARAMETER

Adds an additional parameter to the data table and graph. All available parameters that can be added are shown on a list.

FIND

Locates text within the selected parameter. Only one parameter may be searched at a time. A system beep indicates that there are no more occurrences of the desired text.



FIND AGAIN

Locates the text that was most recently searched for within the selected parameter. Only one parameter may be searched at a time.

4.3.3 VIEW

The **View** menu offers the following commands:

TOOLBAR

Use this command to display and hide the **Toolbar**, which includes buttons for some of the most common commands in EcoWatch, such as **File Open**. A check mark appears next to the menu item when the **Toolbar** is displayed.

Shortcut: To hide or display the Toolbar, choose **Toolbar** from the **View** menu.

See **Section 4.2.6, Using the Toolbar,** for a list of the toolbar icons and their functions.

STATUS BAR

Use this command to display and hide the **Status Bar**, which describes the action to be executed by the selected menu item or statuses of keyboard latch state. A check mark appears next to the menu item when the **Status Bar** is displayed.

The right areas of the status bar indicate which of the following keys are latched down:

CAP	The Caps Lock key is latched down.
NUM	The Num Lock key is latched down.
SCRL	The Scroll Lock key is latched down

4-DIGIT YEAR

Use this command to toggle between a date with a two or four digit year on the graph and table.

GRAPH

Use this command to display and hide the **Graph** page when viewing a file. The graph page contains plots of data.

Shortcuts

Toolbar: 

TABLE

Use this command to display and hide the **Table** page while viewing a data file.

Shortcuts

Toolbar: 

GRID

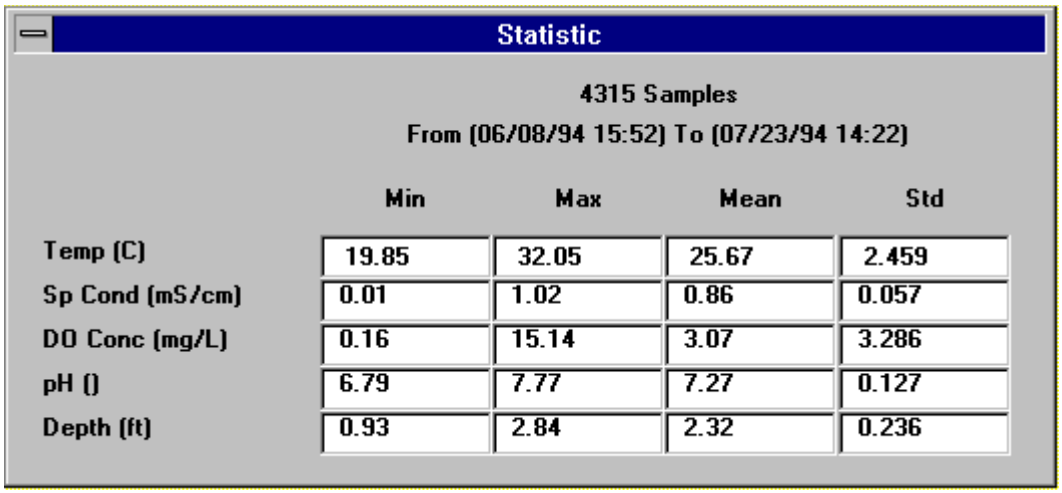
Turns on or off the gridlines on graphs.

MARKERS

Turns on or off data point markers on the graphs. For graphs with more than a few data points we recommend that **Markers** be left off.

STATISTIC

This command will display statistics for the current study. It will show the minimum, maximum, mean, and standard deviation for each of the current parameters. If you click on any minimum or maximum value, then a small box will appear showing the date and time when the minimum or maximum point occurred.

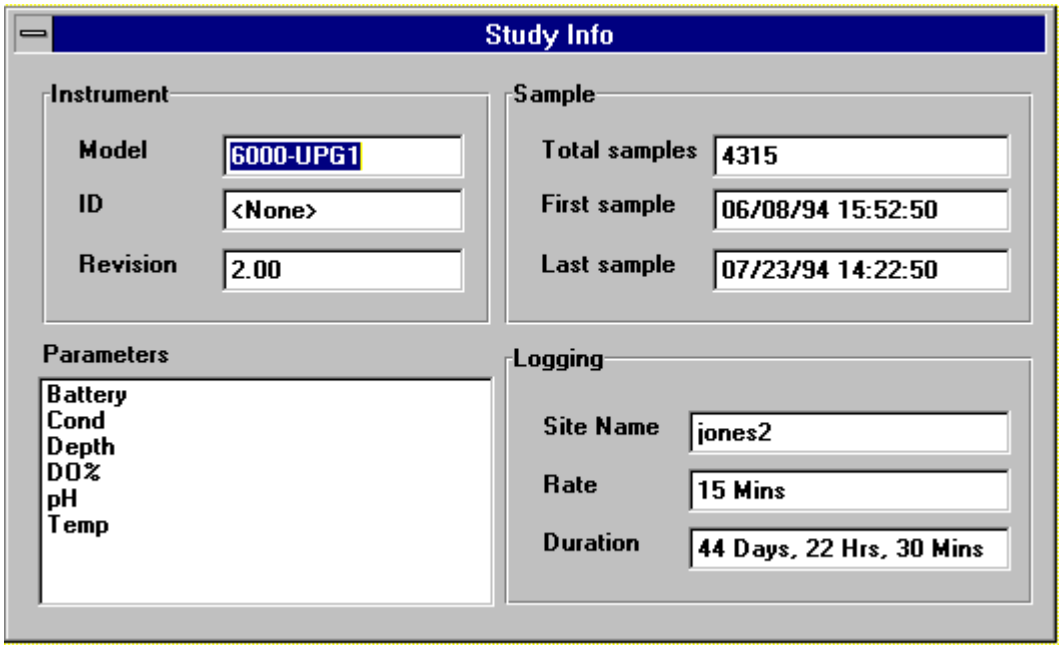


Shortcuts

Toolbar: 

STUDY INFO

This command will display a dialog box describing the study. It will show the sonde type and serial number that was used to collect the data, the parameters available, the logging interval, and the beginning and ending times of the sample.



Shortcuts

Toolbar: 

ZOOM IN

Enlarges graph or data table (whichever is currently active) by 20%.

Shortcuts

Toolbar: 

ZOOM OUT

Reduces graph or data table (whichever is currently active) by 20%. If the graph already extends to both ends of the **Study Limits**, then it is not possible to zoom out any farther and this command will be dimmed.

Shortcuts

Toolbar: 

UNZOOM

Displays the graph all the way to both ends of the **Study Limit** if a graph is selected. Displays the data table in default size, if a data table is selected.

Shortcuts

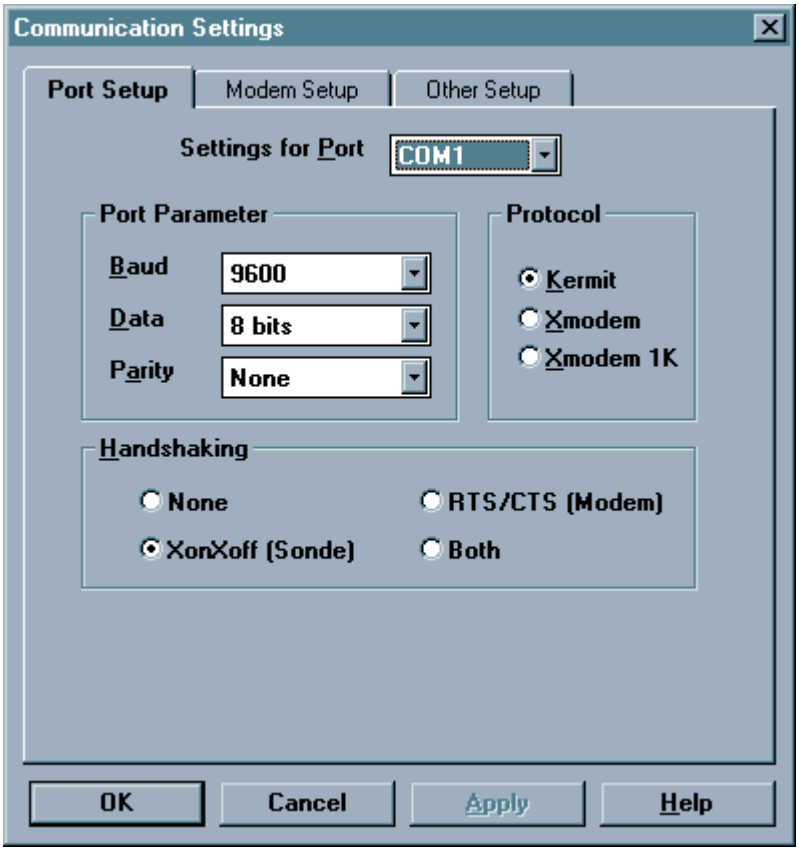
Toolbar: 

4.3.4 COMM(UNICATION)

The **Comm** (Communications) menu commands let you control your communications settings with sondes, modems, and other devices. Several communication menu options are only available when a terminal window is opened.

SETTINGS

The **Communications Settings** dialog box is where you can configure the communications ports. The settings are organized into the following three tabs.



Port Setup

This is where you can set port parameters, file transfer protocol and handshaking for each of the ports that you will use.

- **Port Parameter Setup**
  These include the most common settings for each communication port. These settings are **Baud Rate,** number of **Data** bits, and **Parity**. These settings must be identical to the settings on the device that is connected to the port. You may choose independent settings for each communication port.

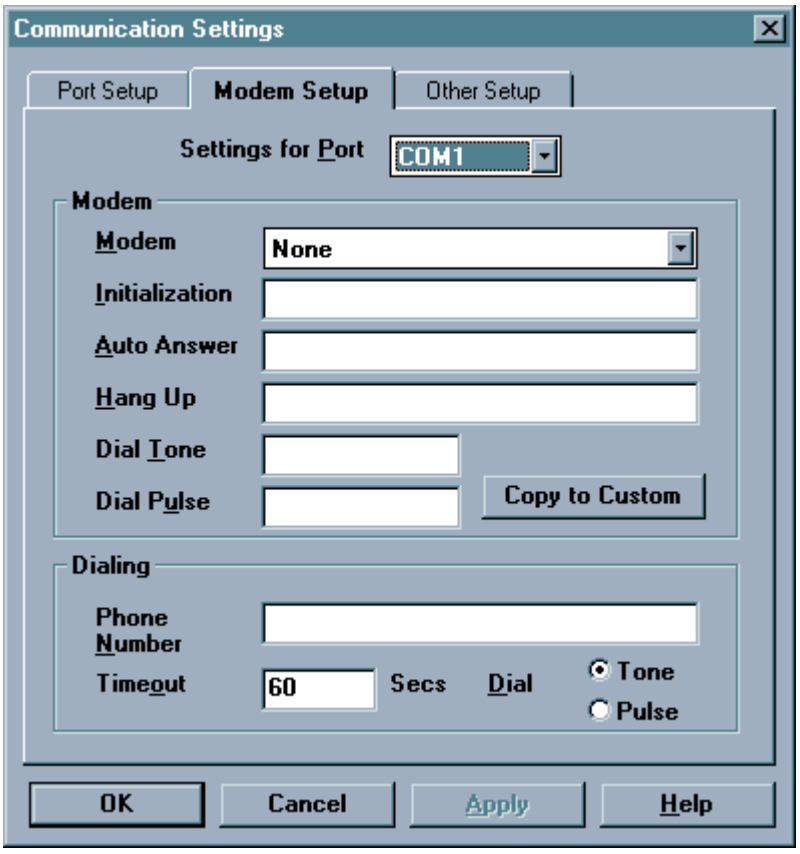
- **Protocol**
  You may choose **Kermit**, **Xmodem** or **Xmodem 1K** protocol for file transfer through the communications port. 6820, 6920, 600R, 600XL, 600XLM and 6600 sondes use only **Kermit** protocol.

- **Handshaking**
  You may choose **Xon/Xoff**, or **RTS/CTS**, or **Both** or **None**. **Xon/Xoff** is often referred to as software handshaking and RTS/CTS as hardware

handshaking. If you are using a YSI sonde select **Xon/Xoff**. Modems usually require **RTS/CTS**.

- **Modem Setup**
  This is where you enter the settings for your modem. Note that you can have several modems, each on separate COM ports, and each with its own settings.

  If a modem is selected for a particular COM port, then every time that port is opened, EcoWatch will attempt to initialize a modem on that port. If the attempt fails, then EcoWatch will open a terminal window and you can communicate to that port with the computer keyboard. This can be very helpful in troubleshooting a connection to your modem or in determining exactly which settings work with your modem.



- **Modem**
  To setup a particular modem on your first try, select that modem from the **Modem** list. The only settings that you can edit are for the **Custom** modem.

  If your modem does not work, select “Hayes Compatible” modem. Those settings are quite common and might work for your modem. If neither approach works, then you will have to define your own settings. You will need the instruction manual for your modem. It should list all

of the proper settings. Choose **Custom** from the **Modem** list and enter the settings for your modem.

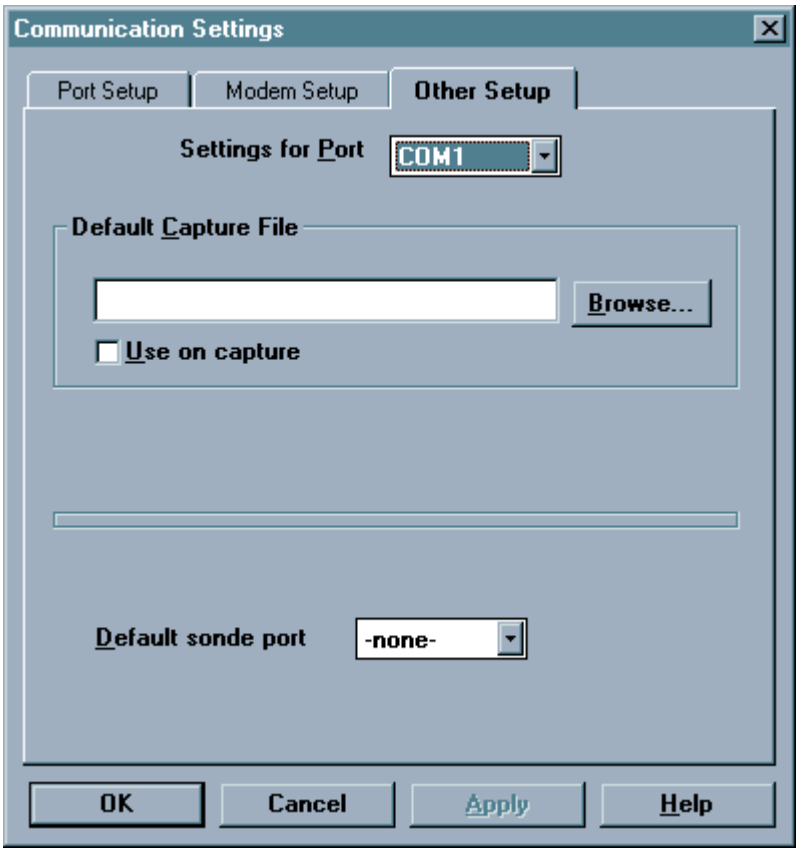
The **Auto Answer** setting is included in the dialog for completeness. EcoWatch currently does not use **Auto Answer**.

- **Copy to Custom**
  The **Copy to Custom** button is sometimes helpful in defining your own settings. If there is a similar modem, choose it from the list, and then click **Copy to Custom**. Choose **Custom** from the list and edit the settings. It transfers all modem settings from the currently selected modem to the "Custom" modem so you can modify the setting later.

- **Dialing**
  If there is no entry for **Phone Number**, then every time you choose an option that opens the COM port that connected to a modem, EcoWatch will ask you for a phone number. **Timeout** specifies how long in seconds EcoWatch will wait for the phone to answer.
  Use the **Dial** option to select **Tone** or **Pulse** dialing.

Other Setup

This is where you choose a default port for communicating with a sonde and default capture files for each sonde port. This tab addresses several COM port settings not covered on the other two tabs.



- **Default Capture File**

  While communicating to a sonde in terminal mode using the Sonde command, you may want to capture measurements to a file. You may type in a default file name in the accompanying text box.

  If you specify a file name here and select the Use on Capture check box, then whenever you capture data, the program will write to that file without first asking you to confirm. If you specify a file but do not select the check box, then you will have to confirm that this is the file you wish to have your data written to before starting to capture.

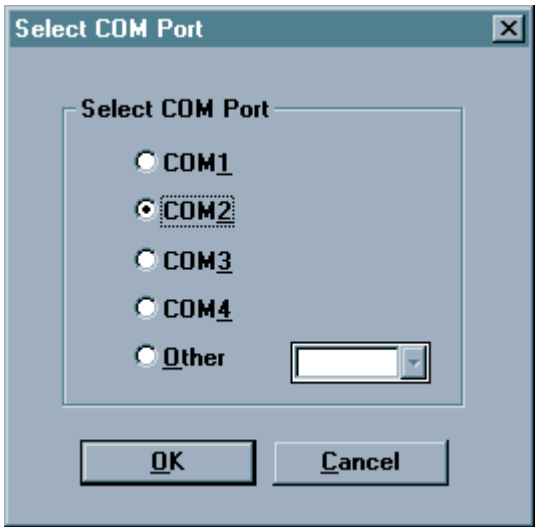
- **Default Sonde Port**

  This refers to the COM port you will most commonly use to connect to your sonde. If you select a port here, EcoWatch will automatically use this port as the default COM port when you use the Sonde command.

The **Apply** button in the bottom of this dialog box is not used in EcoWatch.

SONDE

This command opens a terminal window for communicating with a sonde. From the terminal window you can communicate to a sonde using the sonde menus. Unless you have chosen a default sonde port in the **Communications Settings** dialog box the following dialog box will appear asking you which COM port to use.



Shortcuts

Toolbar: 

TERMINAL

Opens a new terminal window for communicating with any compatible RS-232 devices.

FONT/COLOR

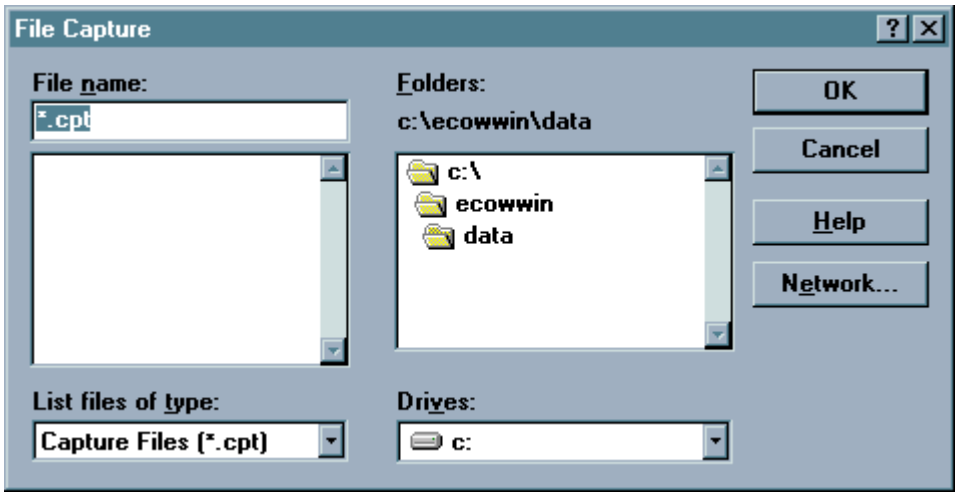
Adjust font color, size, and style for any text that appears in the terminal window.

BACKGROUND COLOR

Adjust the background color of the terminal window.

CAPTURE

Turns COM port capture **On** or **Off**. This is typically used while communicating with a sonde that is taking measurements. Capture will send all communications received on the COM port to a file. After selecting the command, a dialog box will appear for selecting the name of the file to use. If “Use default capture” file was checked in Communications Settings, EcoWatch will not display this dialog.



A common example is using a sonde in **Run Mode**. The sonde is simply taking readings and sending them to the COM port. If you want to keep a record of these readings, then a simple way to do so is to turn **Capture** on. When you are finished, run the **Capture** command again to turn it off.

FILE UPLOAD

Use this command to upload files from any device that uses **Xmodem** file transfer protocol. First initiate the upload from the device, then choose this command. This command is enabled only when the **Xmodem** or Xmodem 1K protocol has been selected in **Port Setup**.

DIAL MODEM

If you have specified a default phone number in the **Modem** tab of the communications **Settings** dialog box, then this command will call that number. If you have not specified a default number, then you will be asked for a number.

HANG-UP MODEM

Hangs up phone and halts communication with the modem.

SEND ASCII FILE

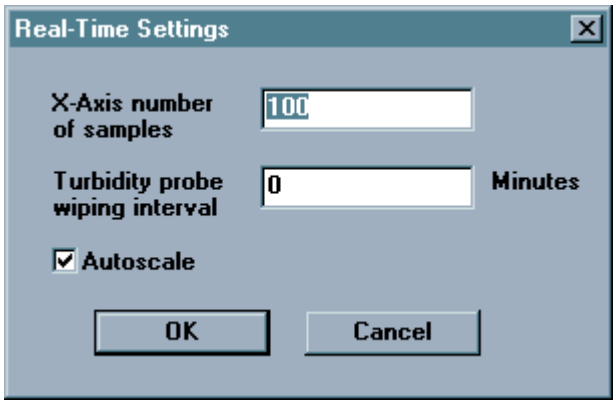
Sends a file in to the device connected to the terminal using plain ASCII protocol. No handshaking or error correction is involved.

SEND XMODEM FILE

Sends a file to the device connected to the terminal using **XModem** protocol.

4.3.5 REAL-TIME

The **Real-time** menu offers the following commands that allow you to control how your data will be presented.



SETTINGS

This command is only active when there is a real-time window open. This command takes you to the **Real-time Settings dialog** where you can set the length of the x-axis.

In the Real-Time Settings box you will set the number of samples graphed across the axis. (The interval between samples is set in the sonde using the sonde menus.) After the graph is full, each new data point will cause the trace to scroll left so that you see only the most recent set of measurements.

If you have a YSI 6026 Turbidity or 6025 chlorophyll probe with a wiper, then you may want to clean the optics periodically. Set that interval in this dialog.

Autoscaling will keep the trace comfortably on the graph as the measurement changes.

To **Manually Scale** a graph; double-click on its Y-axis labels. The Graph Y-Axis box will come up where you can set the scale. Note that you can manually set the scale for some parameters and autoscale others. When the autoscale box is checked, the high and low limits will be unavailable. See also the **Autoscale** command in the **Graph** menu.

NEW

Choose this to start a new real time study.

OPEN

Choose this to open a previous real time study.

CLOSE

Choose this to close a real time study.
Two files are formed every time a real time study is started. You will choose a .RT file that will store colors, scaling information, number of parameters and other information useful to the program. At the same time, the program starts another file with the same name but a .DAT extension for the actual measurements that are taken during the study.

4.3.6 GRAPH

ZOOM WINDOW

Enlarges a section of the graph. The pointer will change to a magnifying glass and then you can click and drag on the graph to indicate the section you want to view. This command stays active until you execute it again.

Shortcuts

Toolbar: 

CENTER SCROLL

Centers graph at the mouse cursor. The pointer will change to a bullseye. Clicking anywhere on the graph will cause that point to be moved to the center. This command stays active until you execute it again.

Shortcuts

Toolbar: 

LIMIT DATA SET

This command limits the amount of data being processed. If you are not presently interested in portions of the graph or table at the beginning or end of the study, you may want to use this command to indicate only that portion that you are interested in. The program will have fewer data points to handle and will respond to your commands quicker. Executing this command when modifying a graph will change the pointer to a vertical arrow. Click once on the left end of that part of the graph that you want and then click again at the right end. This command stays active until you execute it again.

To limit the data in a table, move the pointer to the far left of the table into the row numbers area and highlight from the desired cutoff point to the beginning or end of the data set, whichever is desired. Then select the **Limit Data Set** option from the graph menu or use the toolbar shortcut.

To undo the limits choose **Cancel Limits** below. Alternately, you may remove the limits on a graph by executing this command backwards. That is, click anywhere on the right side of the

graph first, and then click anywhere on the left side. The limits will be moved to the ends of the file.

Shortcuts

Toolbar: 

AUTOSCALE

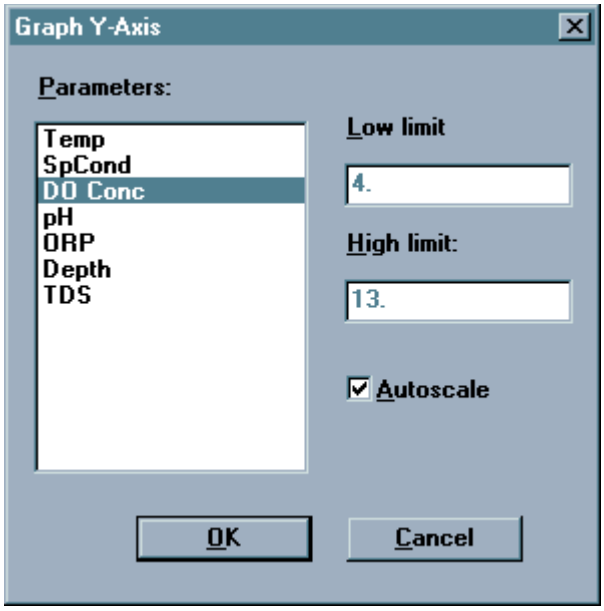
Sets the scale of each parameter so that the minimum and maximum points fit comfortably on the graph.

MANUAL SCALE

Takes you to the **Graph Y-Axis** dialog box where you can set the scale for each parameter.

Graph Y-axis dialog box

To manually scale a graph, double click on its Y-axis labels. A dialog will come up where you can set the scale. Note that you can manually set the scale for some parameters and autoscale others. When the autoscale box is checked, the high and low limits will be dimmed. See also the Autoscale command in the Graph menu.



.

REDRAW

If part of a graph is not displayed it could be because your window is sized too small to display it or because you have just returned to EcoWatch from some other application. Maximizing the window and choosing this command should display your graph correctly

Shortcuts

Toolbar: 

CANCEL LIMITS

Choose this command to cancel the limits set by the **Limit Data Set** command.

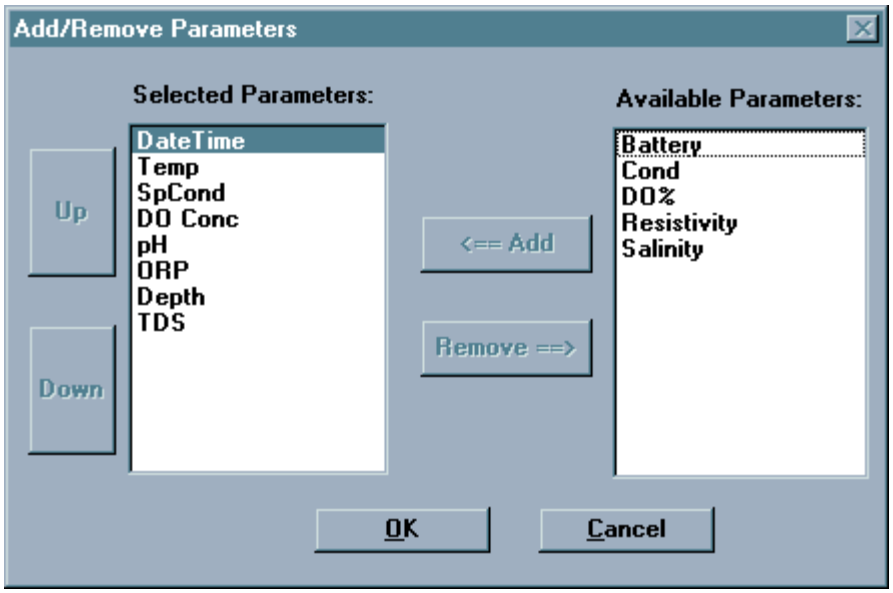
4.3.7 SETUP

PARAMETER

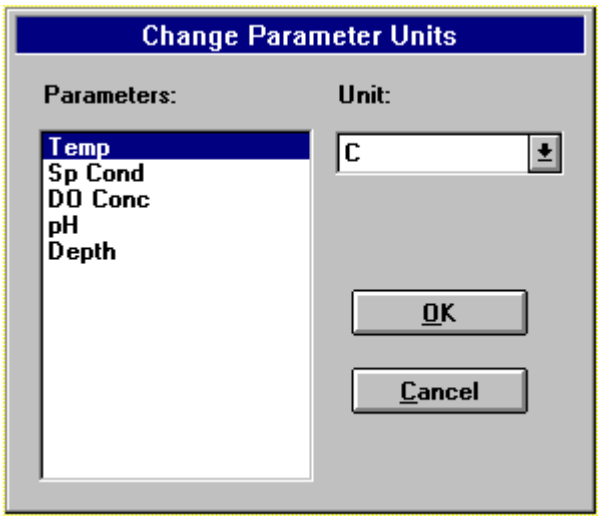
Lets you select which parameters you want to analyze and how they will appear.

Add/Remove
There are two lists, **Selected Parameters** and **Available Parameters**. If, for example, you wish to graph another parameter, you must highlight it on the **Available Parameter** list and then click the Add button to move it over to the **Selected Parameters** list. This is also where you decide the order in which the parameters will appear in both the table and the graphs. If you choose to have two traces per graph, then the first graph will have the first and second parameters on this list, the second graph will have the third and fourth parameters and so forth. The parameters will appear in the **Selected Parameters** list in the order that they were added. To rearrange the order, highlight the parameter you wish to move and then use the up and down buttons to move it to the desired spot in the order.

The **TSS parameter** (only available if your sonde has a Turbidity sensor) is a parameter that is not part of your original collected data. TSS is calculated by EcoWatch, which uses the Turbidity data and a set of correlation points that you enter. When you add TSS, a TSS calibration window will popup and prompt you for a set of correlation points. For more information see **Calibrate TSS**.

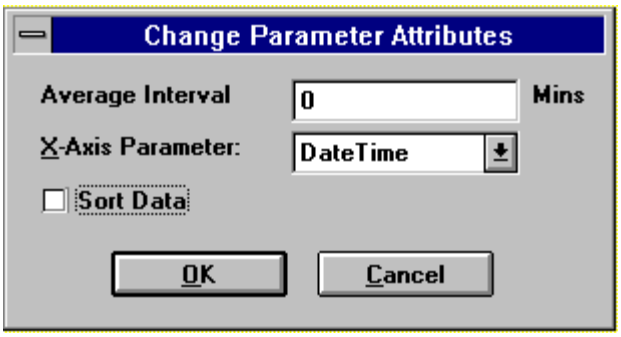


Units
Select the units for any parameter. It will take you to the **Change Parameter Units** dialog box. You may choose the units for each of the selected parameters. Many parameters have only one possible choice of units. DO concentration, for example; can only be expressed in mg/L. pH has no units at all.



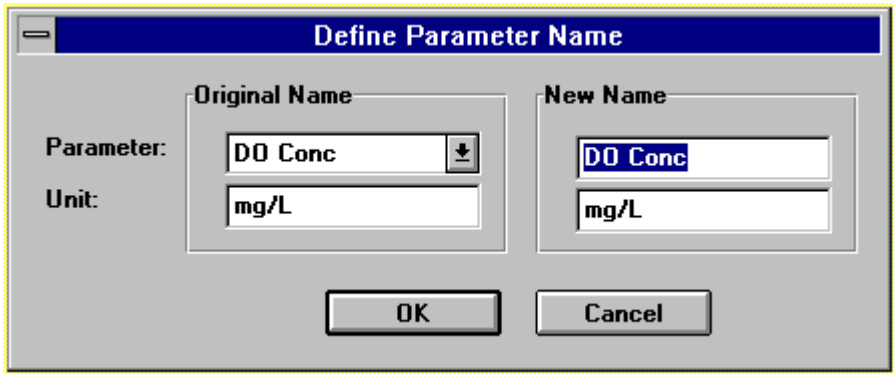
Attributes
This command takes you to the **Change Parameter Attributes** dialog box where you have access to two powerful features. You can choose to display an average of your data, or graph the data with some parameter other than time for the x-axis. The most common use for this latter feature is to graph temperature and DO versus depth. Other combinations are possible. You may choose to average the data before it is graphed. An interval of 0 will cause there to be no averaging at all. The larger the averaging interval, the more points will be used in each average. For example, if you acquired data every 15 minutes and you set the average interval to 60 minutes, each set of four points will be averaged and then plotted as a single point. This feature will not only smooth a graph, but will also reduce the amount of data exported that is sometimes convenient when exporting to a spreadsheet.

The x-axis parameter is normally **Time**, but you can choose any parameter you like. By default, data files are sorted by increasing time. If you have chosen another parameter for the x-axis, then you may want to have the data sorted before graphing it.



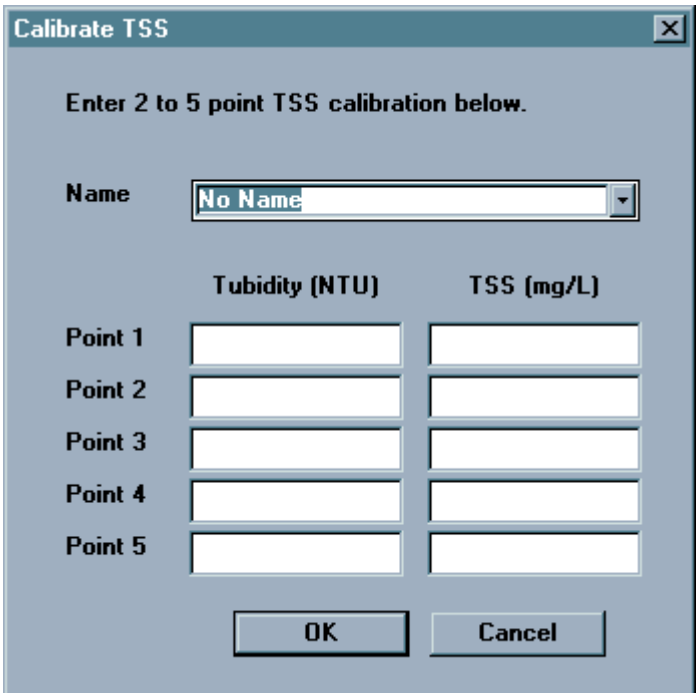
Change name
This command takes you to the **Define Parameter Name** dialog box where you may change the default names of the parameters.

This dialog is intended to make changes like "degrees Celsius" to "degrees C". If you change "degrees Celsius" to "degrees Fahrenheit", then the data displayed will be in degrees Celsius even though the graph says "degrees Fahrenheit." To change the units for that parameter, use the **Change Parameter Units** dialog box.



Calibrate TSS

TSS is an abbreviation for Total Suspended Solids. TSS is a unit derived from a Turbidity (NTU) measurement and correlated TSS-NTU measurements. The Calibrate TSS feature is only used if the TSS parameter has been added to the



current data file using **Add/Remove Parameters**. This command opens the TSS Calibration window and allows calibration adjustment.

How do I add TSS to my data file?

You must have a data set that includes Turbidity data points.

It is also common to use a 0 to 0 correlation as a base point in these measurements. This can be used as the first correlation point. You need to establish a correlation between your Turbidity reading and a TSS value. This is done by taking a sample and noting its Turbidity in NTU's. Then run a lab analysis to obtain a total suspended solids reading. You have now determined one correlation point.

Once you have at least two correlation points, you have established a linear correlation between the two measurements. EcoWatch allows you to enter up to five correlation points. The more correlation points you have, the higher that your accuracy will be.

To add the TSS parameter to your data file, go to the **Setup** menu. Choose **Parameters**, then **Add/Remove**. Select the **TSS** parameter and click the **Add** button. The Calibrate TSS window will appear.

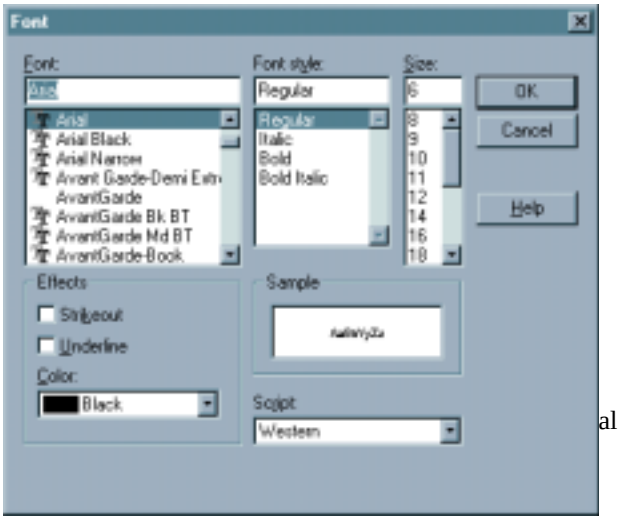
Name the file for identification in the future. Multiple calibration files may be created. Any previously created calibration files will be located in the drop-down name list box.

Once you have entered the desired number of correlation points, click **OK**. EcoWatch will calculate the TSS values by doing a linear interpolation of the Turbidity (NTU) data and the correlation chart .

GRAPH

The **Setup** menu, **Graph** submenu has the following commands:

Font/Color
Goes to the **Font Dialog Box** where you can change the font and color of text that appears in the graph.



- **Font**
  Type or select a font name. EcoWatch lists the fonts available with the current printer driver and additional fonts installed in your system.

- **Font Style**
  Select a font style. To use the default type style for a given font, select Regular.

- **Size**
  Type or select a font size. The sizes available depend on the printer and the selected font. If the size you type is not available on the current printer, EcoWatch chooses the closest available size.

- **Effects**
  Choosing **Strikeout** will draw a line through all text in the table. Choosing underline will underline the text.

- **Color**
  Type or select one of the 16 predefined colors. To display color, you must have a color monitor; to print color, you must have a color plotter or a color printer.

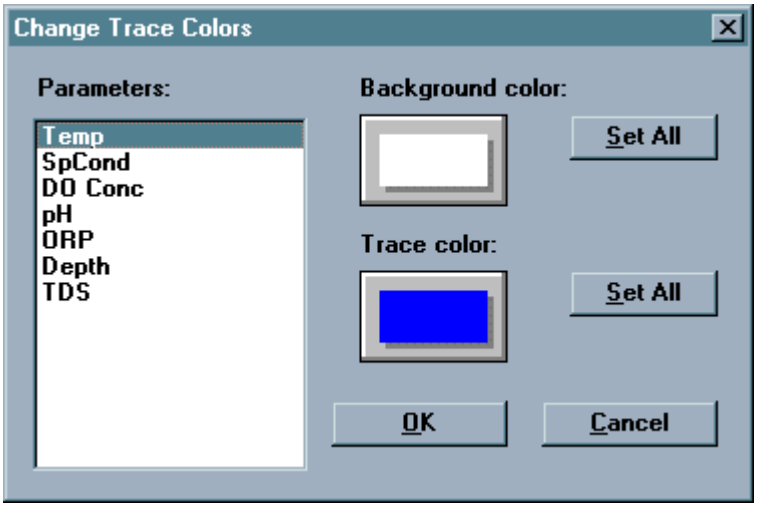
- **Sample**
  Shows the effects of the formatting you specify before you apply it to the document.

Page Color

Goes to the **Color Dialog Box** where you can change the color of the graph page. This is the background for all of the graphs rather than the background for each individual graph that is set with the next command.

Trace Color

Goes to the **Change Trace Color** dialog box where you can change the color of the trace and the background for each of the individual graphs. For setting the background color for all graphs, see the previous command.

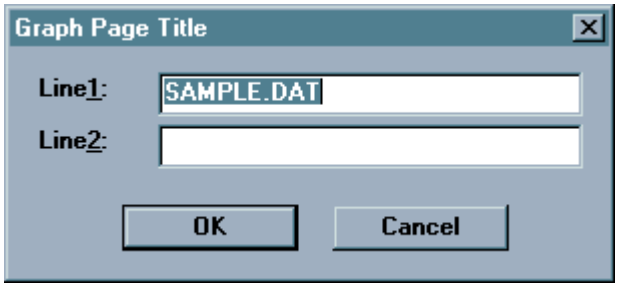


Note that there are two color buttons, one for the trace color and the other for the background color. Clicking on either of these buttons will take you to the **Color** dialog box where you can change the color.

Use the **Set All buttons** to quickly set all traces or backgrounds to the same color.

Page Title

This is where you can enter a title for the graph. The title may have one or two lines.



1 Trace per Graph

Choose this to have just one parameter on each graph.

2 Traces per Graph

Choose this to have two parameters on each graph.

TABLE

If there is no table, then the commands on this submenu will be unavailable. The Table submenu offers the following commands:

Font/Color
Goes to the Font Dialog Box where you can change the font and color of text that appears in the table.

Page Color
Goes to the Color Dialog Box where you can change the color of the table background color. That is the part of the table where the readings appear.

Highlight Color
Goes to the Color Dialog Box where you can change the color of the table highlight color. That is the part of the table where the reading units appear.

SET DEFAULT TEMPLATE

This option allows you to select display parameters for your data when you initially open a file in EcoWatch. Display parameters include background and trace colors on your graph, which parameters are displayed, parameter ordering, parameter units, and scaling of those parameters (either manual or automatic). The first time you use EcoWatch with a data file, graphing will proceed according to the default settings present in EcoWatch. For example, graph backgrounds will all be black, traces will be plotted each with a different color, all parameters will be auto-scaled, and if your sonde measures conductivity and dissolved oxygen, EcoWatch will display specific conductance in mS/cm and dissolved oxygen in mg/L. You can change the default settings by using **Set Default Template.**

1 - Open a data file and observe the presentation of the data in graphic and tabular form.

2 - You can change the background and trace colors by going into the **Graph** and/or **Table submenus** of the **Setup Menu**.

3 - You can add or remove parameters by going into the **Parameter submenu** of the **Setup Menu**.

4 - You can change the units of the displayed parameters by going into the Parameter submenu of the Setup Menu.

5 - You can change the order of the parameters by going into the **Add/Remove Parameters dialog box** in the **Parameter submenu** of the **Setup Menu**.

6 - You can set the scaling options for your data by double-clicking on the Y-axis of the graph and using the **Graph Y-Axis dialog box** to set the scales.

7 - After setting the display parameters enter the **Setup Menu** and choose **Set Default Template**. Now every data file that you initially open will use the display parameters

that you have chosen. If you want to delete your template, enter the **Setup Menu** and choose **Clear Default Template**.

CLEAR DEFAULT TEMPLATE

This command will eliminate a default template that has been saved. With no default template, all new EcoWatch files open in whatever form they were saved in.

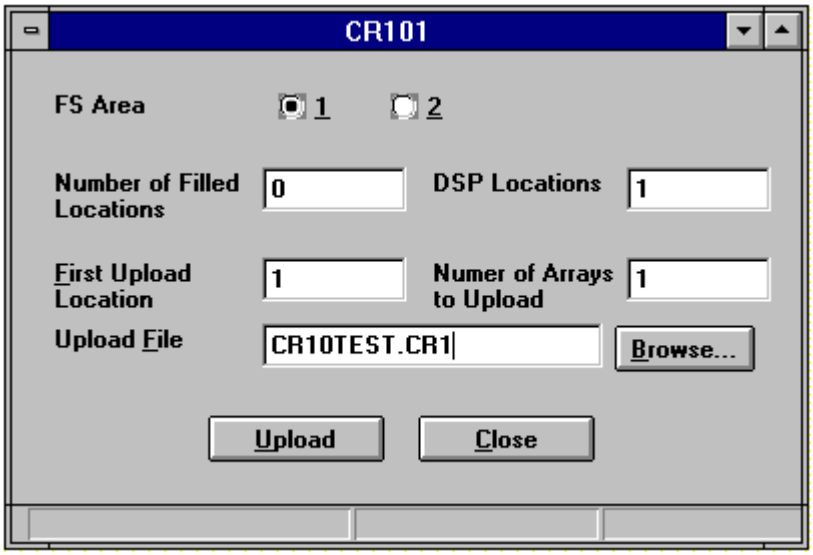
4.3.8 APPL(ICATIONS)

The **Appl** menu is the link to other Application programs that can be used with EcoWatch. For Help using a GIS software, consult the menu that came with the GIS system.

To upload from a Campbell Scientific CR10 Logger, first connect the logger to a COM port using a Campbell Scientific SC32A Adapter. Set the port for 9600 Baud, 8 data bits, no parity and Xon/Xoff handshaking. Then from the EcoWatch **Appl** menu, select **CR10 Upload.** The dialog box below will appear.

The items Number of Filled Locations and DSP Locations are information from the logger that you cannot change. FS Area, First Upload Location, and Number of Arrays to Upload are fields that you must enter. Refer to your CR10 manual for instructions.

Select a destination file (under Upload File; use the Browse button as needed) and click Upload.



4.3.9 WINDOW

The Window menu offers the following commands that enable you to arrange multiple views of multiple documents in the application window:

CASCADE

Use this command to arrange multiple opened windows in an overlapped fashion

TILE HORIZONTAL

Use this command to vertically arrange multiple opened windows in non-overlapped horizontal tiles.

TILE VERTICAL

Use this command to arrange multiple opened windows side by side.

ARRANGE ICONS

Use this command to arrange the icons for minimized windows at the bottom of the main EcoWatch window. If there is an open document window at the bottom of the main window, then some or all of the icons may not be visible because they will be underneath this document window.

WINDOW 1, 2...

EcoWatch displays a list of currently open document windows at the bottom of the Window menu. A check mark appears in front of the document name of the active window. Choose a document from this list to make its window active.

4.4.10 HELP

The Help menu offers the following commands, which provide you assistance with this application:

CONTENTS

Offers you a list of the available Help topics.

USING HELP

Use this command for instructions about using Help.

TECHNICAL SUPPORT

YSI Technical support phone number.

ABOUT

Displays the version number of this application.

SECTION 5 PRINCIPLES OF OPERATION

5.1 CONDUCTIVITY

The sondes utilize a cell with four pure nickel electrodes for the measurement of solution conductance. Two of the electrodes are current driven, and two are used to measure the voltage drop. The measured voltage drop is then converted into a conductance value in milli-Siemens (millimhos). To convert this value to a conductivity value in milli-Siemens per cm (mS/cm), the conductance is multiplied by the cell constant that has units of reciprocal cm (cm^{-1}). The cell constant for the sonde conductivity cell is approximately 5.0/cm. For most applications, the cell constant is automatically determined (or confirmed) with each deployment of the system when the calibration procedure is followed. Solutions with conductivities of 1.00, 10.0, 50.0, and 100.0 mS/cm, which have been prepared in accordance with recommendation 56-1981 of the Organization International De Metrologie Legale (OIML), are available from YSI. The instrument output is in mS/cm or uS/cm for both conductivity and specific conductance. The multiplication of cell constant times conductance is carried out automatically by the software.

CALIBRATION AND EFFECT OF TEMPERATURE

The conductivity of solutions of ionic species is highly dependent on temperature, varying as much as 3% for each change of one degree Celsius (temperature coefficient = 3%/°C). In addition, the temperature coefficient itself varies with the nature of the ionic species present.

Because the exact composition of a natural media is usually not known, it is best to report a conductivity at a particular temperature, e.g. 20.2 mS/cm at 14 °C. However, in many cases, it is also useful to compensate for the temperature dependence in order to determine at a glance if gross changes are occurring in the ionic content of the medium over time. For this reason, the sonde software also allows the user to output conductivity data in either raw or temperature compensated form. If Conductivity is selected, values of conductivity that are *NOT* compensated for temperature are output to the report. If Specific Conductance is selected, the sonde uses the temperature and raw conductivity values associated with each determination to generate a specific conductance value compensated to 25°C. The calculation is carried out as in equation (1) below, using a temperature coefficient of 1.91%/°C (TC = 0.0191):

$$\text{Specific Conductance } (25^{\circ}C) = \frac{\text{Conductivity}}{1 + TC * (T - 25)}$$

As noted above, unless the solution being measured consists of pure KCl in water, this temperature compensated value will be somewhat inaccurate, but the equation with a value of TC = 0.0191 will provide a close approximation for seawater and for solutions of many common salts such as NaCl and NH_4Cl.

MEASUREMENT AND CALIBRATION PRECAUTIONS

1 - When filling the calibration vessel prior to performing the calibration procedure, make certain that the level of calibrant standard is high enough in the calibration cup or beaker to cover the entire conductivity cell.

2 - After placing the sonde in the calibration solution, agitate the sonde to remove any bubbles in the conductivity cell.

3 - During calibration, allow the sensors time to stabilize with regard to temperature (approximately 60 seconds) before proceeding with the calibration protocol. The readings after calibration are only as good as the calibration itself.

4 - Perform sensor calibration at a temperature as close to 25°C as possible. This will minimize any temperature compensation error.

5.2 SALINITY

Salinity is determined automatically from the sonde conductivity and temperature readings according to algorithms found in *Standard Methods for the Examination of Water and Wastewater (ed. 1989).* The use of the Practical Salinity Scale results in values that are unitless, since the measurements are carried out in reference to the conductivity of standard seawater at 15 °C. However, the unitless salinity values are very close to those determined by the previously used method where the mass of dissolved salts in a given mass of water (parts per thousand) was reported. Hence, the designation “ppt” is reported by the instrument to provide a more conventional output.

5.3 OXIDATION REDUCTION POTENTIAL (ORP)

The sondes determine the Oxidation Reduction Potential (ORP) of the media by measuring the difference in potential between an electrode which is relatively chemically inert and a reference electrode. To measure ORP with a sonde, a combination pH/ORP probe must be in place in the sonde bulkhead and ORP must be accessed via the ISE2 channel of the sonde. The ORP sensor consists of a platinum button found on the tip of the probe. The potential associated with this metal is read versus the Ag/AgCl reference electrode of the combination sensor that utilizes gelled electrolyte. ORP values are presented in millivolts and are not compensated for temperature.

CALIBRATION AND EFFECT OF TEMPERATURE

Calibration may not be required for the ORP sensor of the sonde when it is new. However, older probes that have been deployed extensively may show some deviation from the theoretical ORP value. This deviation is usually due to a change in the concentration of the KCl in the reference electrode gel. To determine whether the sensor is functioning correctly, place the ORP probe in 3682 Zobell solution and monitor the millivolt reading. If the probe is functioning within specifications, the ORP reading should be within the range of 221-241 at normal ambient

temperature. If the reading is outside of this range, the probe can be calibrated to the correct value (231 mV at 25°C) using the calibration procedure outlined in **Section 2.6.1, Calibration.**

ORP readings for the same solution can vary up to 100 mv depending on the temperature. However, no standard compensation algorithms exist for this parameter. Be sure to take this factor into account when reporting ORP values and checking sensor calibration. For Zobell solution, consult the following chart:

TEMPERATURE, CELSIUS	ZOBELL SOLUTION VALUE, MV
-5	270.0
0	263.5
5	257.0
10	250.5
15	244.0
20	237.5
25	231.0
30	224.5
35	218.0
40	211.5
45	205.0
50	198.5

MEASUREMENT AND CALIBRATION PRECAUTIONS

1 - Instructions for preparation of ORP calibrator solutions (including Zobell reagent) can be found in Section 2580 A. of *Standard Methods for the Examination of Water and Wastewater.* Alternatively, the Zobell solution is available from YSI.

2 – Reagants to confirm ORP sensitivity are available. See **Appendix C, Accessories** for ordering information.

3 - ORP readings usually stabilize much more rapidly in standards (e.g., Zobell solution) than in most environmental water. Be certain to consider this factor when determining ORP in field studies.

4 - Clean and store the pH/ORP sensor by following the instructions in **Section 2.10, Care, Maintenance and Storage** of this manual.

5.4 pH

The sondes employ a field replaceable pH electrode for the determination of hydrogen ion concentration. The probe is a combination electrode consisting of a proton selective glass reservoir filled with buffer at approximately pH 7 and a Ag/AgCl reference electrode that utilizes electrolyte that is gelled. A silver wire coated with AgCl is immersed in the buffer reservoir. Protons (H^+ ions) on both sides of the glass (media and buffer reservoir) selectively interact with the glass, setting up a potential gradient across the glass membrane. Since the hydrogen ion concentration in the internal buffer solution is invariant, this potential difference, determined relative to the Ag/AgCl reference electrode, is proportional to the pH of the media. The pH system of the 600R utilizes individual glass sensing and reference electrodes, but the operating principle is the same.

Our testing of the 6561 pH, 6565 pH/ORP sensors and 600R pH system indicates that they should provide long life, good response time, and accurate readings in most environmental waters, including freshwater of low ionic strength. Thus, no special sensor is required (nor offered) for water of low conductivity.

CALIBRATION AND EFFECT OF TEMPERATURE

The software of the sondes calculates pH from the established linear relationship between pH and the millivolt output as defined by a variation of the Nernst equation:

$$E = E_o + \frac{2.3RT}{nF} * pH$$ where E = millivolts output

E_o = a constant associated with the reference electrode

T = temperature of measurement in degrees Kelvin

R, n, and F are invariant constants

Thus, in simplified ***y = mx + b*** form, it is (mv output) = (slope)x(pH) + (intercept). In order to quantify this simple relationship, the instrument must be calibrated properly using commercially available buffers of known pH values. In this procedure, the millivolt values for two standard buffer solutions are experimentally established and used by the sonde software to calculate the slope and intercept of the plot of millivolts vs. pH. Once this calibration procedure has been carried out, the millivolt output of the probe in any media can readily be converted by the sonde software into a pH value, *as long as the calibration and the reading are carried out at the same temperature*. This last qualifier is almost never met in actual environmental measurements since temperatures can vary several degrees during a deployment simply from a diurnal cycle. Thus, a mechanism must be in place to compensate for temperature or, in other words, to accurately convert the slope and intercept of the plot of pH vs. millivolts established at T_c (temperature of calibration) into a slope and intercept at T_m (temperature of measurement). Fortunately, the Nernst equation provides a basis for this conversion.

According to the Nernst equation as shown above, the slope of the plot of pH vs. millivolts is *directly proportional* to the absolute temperature in degrees Kelvin. Thus, if the slope of the plot is experimentally determined to be 59 mv/pH unit at 298 K (25 C), then the slope of the plot at 313 K (40 C) must be (313/298) * 59 = 62 mv/pH unit. At 283 K (10 C), the slope is calculated to be 56 mv/pH unit ((283/298) * 59). Determination of the slope of pH vs. mv plots at

temperatures different from T_c is thus relatively simple. In order to establish the intercept of the new plot, the point where plots of pH vs. mv at different temperatures intersect (the isopotential point) must be known. Using standard pH determination protocol, the sonde software assigns the isopotential point as the mv reading at pH 7 and then calculates the intercept using this assumption. Once the slope and intercept to the plot of pH vs. mv are assigned at the new temperature, the calculation of pH under the new temperature conditions is straightforward, and is automatically carried out by the sonde software.

MEASUREMENT AND CALIBRATION PRECAUTIONS

1- When filling the calibration cup prior to performing the calibration procedure, make certain that the level of calibrant buffers is high enough in the calibration/storage cup to cover the 6561 or 6565 pH probe and the temperature sensor of the 6560 probe.

2 - Rinse the sensors with deionized water between changes of calibration buffer solutions.

3 - During pH calibration, allow the sensors time to stabilize with regard to temperature (approximately 60 seconds) before proceeding with the calibration protocol. The pH readings after calibration are only as good as the calibration itself.

4 - Clean and store the probe according to the instructions found in **Section 2.10, Care, Maintenance and Storage** of this manual.

5.5 DEPTH AND LEVEL

The sondes can be equipped with either depth or level sensors. In fact, both sensors measure depth, but by convention, level refers to vented measurements and depth refers to non-vented measurements. Both measurements use a differential strain gauge transducer to measure pressure with one side of the transducer exposed to the water.

For depth measurements, the other side of the transducer is exposed to a vacuum. The transducer measures the pressure of the water column plus the atmospheric pressure above the water. Depth must be calculated from the pressure exerted by the water column alone; therefore, when depth is calibrated in air, the software records the atmospheric pressure and subtracts it from all subsequent measurements. This method of compensating for atmospheric pressure introduces a small error. Because the software uses the atmospheric pressure at the time of calibration, changes in atmospheric pressure between calibrations appear as changes in depth. The error is equal to 0.045 feet for every 1mm Hg change in atmospheric pressure. In sampling applications, frequent calibrations eliminate the error. Considering typical changes in barometer during long-term monitoring, errors of ± 0.6 feet (0.2m) would be common. In applications where this error is significant, we recommend using a level sensor in place of the depth sensor.

As with depth measurements, level uses a differential transducer with one side exposed to the water. However, the other side of the transducer is vented to the atmosphere. In this case, the transducer measures only the pressure exerted by the water column. Atmospheric pressure is ignored and changes in atmospheric pressure do not affect the reading at all.

The voltage output of the transducer is directly proportional to the pressure. The sonde software converts this voltage to a depth reading in feet or meters via calibration parameters that are factory installed. Readings are automatically compensated for the temperature and for the density of the environmental medium that is estimated from the measured salinity.

For more additional information on measuring level, see **Appendix G, Using Vented Level.**

CALIBRATION AND EFFECT OF TEMPERATURE

The depth sensor must be zeroed prior to deployment to account for atmospheric pressure. Level sensors may also require a small adjustment prior to their first use. This procedure is carried out by following the calibration menu instructions with the sonde in air only (do not submerge). The sensors can also be set to any known depth via the calibration routine after they are immersed. The temperature dependence of the sensor is automatically taken into account by the sonde software based on input from factory calibration.

MEASUREMENT AND CALIBRATION PRECAUTIONS

(1) Be certain that the sonde is not immersed in water during the calibration procedure unless you know the exact distance between the sensor and the water surface. Calibration (zeroing) in air is usually the recommended method.

(2) Remember that the depth sensors for the sonde are not vented. In practical terms, this means that changes in barometric pressure after the sensor is calibrated will appear as changes in depth. This effect is significant, particularly for the 0-30 ft option of the depth probe. For example, a change of 1 mm of Hg in barometric pressure will change the apparent depth by approximately 0.045 feet (0.012 m). As noted above, this error is eliminated for level sensors because they are vented to the atmosphere.

5.6 TEMPERATURE

The sondes utilize a thermistor of sintered metallic oxide that changes predictably in resistance with temperature variation. The algorithm for conversion of resistance to temperature is built into the sonde software, and accurate temperature readings in degrees Celsius, Kelvin, or Fahrenheit are provided automatically. No calibration or maintenance of the temperature sensor is required.

5.7 DISSOLVED OXYGEN

The sondes employ the patented YSI Rapid Pulse system for the measurement of dissolved oxygen (DO). Use of this technology provides major advantages for the *monitoring* of DO without significantly compromising the accuracy of *sampling* applications. Standard electrochemical detectors of DO are highly flow-dependent and therefore require external stirring of the medium being evaluated. This stirring must be supplied either by an auxiliary stirrer (which can consume much of the battery reserve in a portable system) or by manually agitating the sonde when carrying out spot sampling applications (which can be inconvenient).

These disadvantages are overcome by the Rapid Pulse dissolved oxygen technology that is associated with the sonde because it needs no stirring to yield accurate readings. In addition, because of the nature of the technology, some effects of fouling of the sensor are minimized.

The Rapid Pulse system utilizes a Clark-type sensor that is similar to other membrane-covered steady-state dissolved oxygen probes. The system still measures the current associated with the reduction of oxygen which diffuses through a Teflon membrane, and this current is still proportional to the partial pressure (not the concentration) of oxygen in the solution being evaluated. The membrane isolates the electrodes necessary for this reduction from the external media, encloses the thin layer of electrolyte required for current flow, and prevents other non-gaseous, electrochemically active species from interfering with the measurement. However, as the user will note from examination of the 6562 probe, the sensor consists of three electrodes (a cathode, anode, and reference electrode) while steady state Clark probes usually have only two electrodes (a cathode and a combined anode-reference electrode). In addition, the geometry of the sensor is novel, consisting of a thin linear gold cathode placed between two silver rectangles which serve as anode and reference electrodes. These sensor changes were required to implement the new Rapid Pulse method for DO measurement as described in the following section.

METHOD OF OPERATION

Standard Clark dissolved oxygen sensors, which are marketed by YSI and other manufacturers, are continuously polarized at a voltage sufficiently negative to cause oxygen to be reduced to hydroxide ion at the cathode and silver metal to be oxidized to silver chloride at the anode. The oxygen diffuses through the Teflon membrane. The current associated with this process is proportional to the oxygen present in the solution outside the membrane. However, as this electrochemical reaction proceeds, oxygen is consumed (or depleted) in the medium, resulting in a decrease in measured current (and apparent oxygen content) if the external solution is not stirred rapidly. To minimize this oxygen depletion, the probe electrodes in the YSI Rapid Pulse system are rapidly and reproducibly polarized (on) and depolarized (off) during a measurement sequence. The Rapid Pulse system thus measures the charge or coulombs (current summed over a specific time period) associated with the reduction of oxygen during a carefully controlled time interval. The coulombs due to charging of the cathode (capacitance), but not to reduction of oxygen, are subtracted during integration after the cathode has been turned off. The net charge, like the steady state current in a standard system, is proportional to the oxygen partial pressure in the medium. Because oxygen is only being reduced 1/100th of the total measurement time, even if the probe is pulsed in this manner continuously, oxygen consumption outside the membrane is kept to a minimum, and the stirring dependence of the system is greatly reduced.

One key to the practicality of Rapid Pulse oxygen system is the fact that the “on time” is very short. This allows the “off time” to also be relatively short and still maintain the off to on ratio of 100 which is necessary to obtain relatively flow independent measurements. The second important aspect of the Rapid Pulse technology is the integration (summing of the current) over the total pulse (on and off). Because the charging current of the electrodes is subtracted in this process, the net signal is due only to the reduction of oxygen. From a practical point of view, this means that when there is zero oxygen partial pressure outside the membrane, the Rapid Pulse signal will also be zero; this in turn allows the system to be calibrated with a single medium (air or water) of known oxygen pressure.

CALIBRATION AND EFFECT OF TEMPERATURE

The sonde Rapid Pulse system is calibrated using the same basic methods employed for steady state oxygen sensors. However, the software that controls the calibration protocol is somewhat different depending on whether the unit will be used in sampling or deployment studies. For sampling studies using either a 610 display unit or a laptop computer, the Rapid Pulse system is allowed to run continuously when the Run mode is activated if "Autosleep" is turned off. Under these software conditions, the user views the DO readings in real time and confirms the calibration manually after the readings have stabilized.

For studies in which the sonde is deployed and readings are saved less frequently (5 – 60 minutes) to sonde memory, a computer or data collection platform, an appropriate warm up time is selected for the system during Sensor setup. Usually 40 seconds is adequate for this parameter, but, in some cases, larger values may result in more accurate results. Most importantly for deployment studies, "Autosleep" should be activated. With these software entries in place, the user will input the calibration value (concentration or barometric pressure), and the unit will automatically calibrate after the selected warm up time.

The description below is designed around deployment applications with "Autosleep" activated.

The two general calibration methods possible with the sonde are "DO mg/L" and "DO %". The former method is designed for calibration in solution while the latter utilizes water-saturated air as the medium. Since the percent saturation (DO %) and concentration (DO mg/L) values are related, calibration by either method results in correct outputs in both units.

If the mg/L method is selected from the sonde Calibrate menu, the oxygen concentration of an aqueous solution may be determined by several methods:

- Winkler titration
- Aerating the solution and assuming that it is saturated, or
- Measurement with another instrument.

If this calibration method is employed, place the sonde into this known-value solution and wait 5-10 minutes for equilibration to occur. Then input the value (in mg/L) into the sonde software and begin the calibration protocol according to the instructions. The calibration will occur automatically at the end of the specified warm-up time.

If the Percent Saturation method is selected, the sonde is simply placed in a calibration cup that contains a small quantity of water or a damp sponge. ***The probe sensor should not be in the water for this calibration procedure.*** The sonde should be left under these conditions for 10-15 minutes to allow temperature and humidity equilibration to occur. Then input the true barometric pressure into the sonde software and begin the calibration protocol according to the instructions. The calibration will occur automatically at the end of the specified warm-up time.
NOTE: Remember that control of the calibration will be manual rather than automatic if the unit is set up properly for spot sampling applications ("Autosleep" deactivated).

The DO readings of steady state oxygen systems are greatly affected by temperature (approximately 3% per degree Celsius) due to the effect of temperature on the diffusion of oxygen through the membrane. The Rapid Pulse system exhibits a greatly reduced effect of temperature

(approximately 1% per degree Celsius), but this factor still must be accounted for if DO readings acquired at temperatures different from that at calibration are to be accurate. The sonde software automatically carries out this compensation.

In addition, the relationship between the measured partial pressure of oxygen (percent saturation) and the solubility of oxygen in mg/L is very temperature dependent. For example, air saturated water (100 percent saturated) at 20 °C contains 9.09 mg/L, but only 7.65 mg/L at 30 °C. The sonde software compensates for both of these temperature-related factors after instrument calibration. The temperature compensation for the percent saturation reading is empirically derived, while the conversion from percent saturation and temperature to a solubility in mg/L is carried out using formulae available in *Standard Methods for the Examination of Water and Wastewater (ed. 1989).* See **Appendix D, Solubility and Pressure/Altitude Tables** for dissolved oxygen solubility tables as a function of salinity and temperature.

FLOW DEPENDENCE

As noted above, oxygen readings acquired using the Rapid Pulse technology are much less affected by sample flow than steady state probes. However, there is a finite stirring dependence exhibited by the Rapid Pulse system if measurements are taken when the probe is being pulsed continuously. Our tests indicate that, under these sampling conditions, observed dissolved oxygen readings can be 2-3 percent lower than the true readings in very still water. Minimal movement of the water (which occurs during most environmental measurements) removes this effect.

This small flow dependence of the sensor is greatly reduced in longer term monitoring deployments where the sampling interval is longer, e.g. 15 minutes. Under these conditions, the sensor is pulsed for only approximately 40 seconds every 15 minutes, and normal diffusion of oxygen in the medium re-establishes the oxygen which has been depleted in the previous warm-up/read sequence.

MEASUREMENT AND CALIBRATION PRECAUTIONS

(1) If water-saturated air is used as the calibrating medium, make certain that *both the DO reading and the temperature* have stabilized (10-15 minutes) before starting the calibration sequence. A wet thermistor can indicate artificially low temperature readings due to evaporation and this situation will result in poor temperature compensation and inaccurate readings.

(2) Insure that the calibration cup being used is vented or pressure released.

(3) For short term storage (2 weeks or less), keep the probe moist when not in use, either by immersing in water or by placing a damp sponge in the calibration vessel. For longer-term storage, remove the probe from the sonde and store it in water with a membrane and electrolyte in place. If the membrane appears to be damaged or has dried out, be sure to replace it prior to calibration and deployment.

(4) For maximum accuracy, calibrate the Rapid Pulse system at a temperature as close as possible to that of the sample being measured. One method of accomplishing this involves immersing the calibration chamber (which contains either a small amount of water or a wet

sponge) into the body of water that is later to be measured. ***Do not allow the sample water to seep into the calibration chamber.*** Monitor the readings. After thermal equilibrium has been established, proceed with the calibration. Note that under normal circumstances this procedure is not required.

(5) Before you install a new membrane, make sure that the O-ring groove and the probe tip are clean and smooth. If the KCl electrolyte solution leaks from the probe surface during monitoring studies, the readings are likely to be less accurate in a shorter period of time.

5.8 NITRATE

The sonde nitrate probe consists of a silver/silver chloride wire electrode in a custom filling solution. The internal solution is separated from the sample medium by a polymer membrane, which selectively interacts with nitrate ions. When the probe is immersed in water, a potential is established across the membrane that depends on the relative amounts of nitrate in the sample and the internal filling solution. This potential is read relative to the Ag/AgCl reference electrode of the sonde pH probe. As for all ISEs, the linear relationship between the logarithm of the nitrate activity (or concentration in dilute solution) and the observed voltage, as predicted by the Nernst equation, is the basis for the determination.

Under ideal conditions, the Nernst equation predicts a response of 59 mV for every 10-fold rise in nitrate activity at 25°C. However, in practice, empirical calibration of the electrode is necessary to establish the slope of the response. Typical slopes are 53-58 mV per decade for YSI sensors. This slope value is determined by calibration with two solutions of known nitrate concentration (typically 1 mg/L and 100 mg/L NO_3-N). The slope of the plot of log (nitrate) vs. voltage is also a function of temperature, changing from its value at calibration by a factor of the ratio of the absolute temperatures at calibration to that at measurement. The point where this new plot of log (nitrate) vs. voltage intersects the calibration plot is called the isopotential point. That is, the nitrate concentration at which changes in temperature cause no change in voltage. Our experience with ISEs indicates that for best accuracy, the isopotential point should be determined empirically. To do so, the user employs a third calibration point where the voltage of the lower concentration standard is determined at a temperature at least 10°C different from the first two calibration points. The slope, offset, and isopotential point drift slowly, and you should recalibrate the probe periodically.

All ion selective electrodes are subject to the interaction of species with the sensor membrane, which are similar in nature to the analyte. For example, chloride ion binds in this way to the nitrate membrane and produces positive nitrate readings even when no nitrate is present in the medium. Fortunately, most fresh water does not usually contain significant quantities of ions that produce a large interference on the nitrate reading, such as azide, perchlorate, and nitrite. It usually does contain some chloride and carbonate ions, but the interference from these ions is relatively small. For example, if the all of the ionic content of water with a conductivity of 1.2 mS/cm (Sal = 0.6) were due to the presence of sodium chloride, the nitrate reading would be erroneously high by about 1.6 mg/L. If the conductivity in this sample were all due to sodium bicarbonate, the sensor output would indicate the presence of only 0.2 mg/L of non-existent nitrate from the interference.

Even though the interference from chloride is relatively small and thus tolerable at low salinity, the large quantity of this species in salt or brackish water creates interference so great as to make the sensor unsuitable for these media.

Despite the potential problems with interference when using ISEs, it is important to remember that almost all-interfering species produce an artificially high nitrate reading. Thus, if the sonde indicates the presence of only small quantities of nitrate, it is unlikely that the reading is erroneously low because of interference. Unusually high nitrate readings (which could be due to interfering ions) should be confirmed by laboratory analysis after collection of water samples.

Ion selective electrodes have the greatest tendency to exhibit calibration drift over time of all the sensors available on the sonde. This drift should not be a major problem for sampling studies where the instrument can be frequently calibrated. However, if a nitrate sensor is used in a longer-term deployment study with the sonde, the user should be aware that drift is almost certain to occur. The extent of the drift will vary depending on the age of the probe, the flow rate at the site, and the quality of the water. For all monitoring studies using ion selective electrodes, the user should acquire a few "grab samples" during the course of the deployment for analysis in the laboratory by chemical means or with another nitrate sensor which has been recently calibrated. Remember that the typical accuracy specification for the sensor (+/- 10 % of the reading or 2 mg/L, whichever is larger) refers to sampling applications where only minimal time has elapsed between calibration and field use.

CALIBRATION AND EFFECT OF TEMPERATURE

The nitrate sensor should be calibrated using solutions of known nitrate-nitrogen content according to the procedures detailed in **Sections 2.6.1 and 2.9.2**. If a two point calibration protocol is used, the temperature of the standards should be as close as possible to that of the environmental medium to be monitored. The recommended calibration procedure is one involving three solutions. Two of the solutions should be at ambient temperature while the third should be at least 10 degrees Celsius different from ambient temperature. This protocol minimizes the effects of taking readings at temperatures that are significantly different from ambient laboratory temperatures.

MEASUREMENT AND CALIBRATION PRECAUTIONS

(1) The temperature response of ion selective electrodes is not as predictable as that of pH sensors. Therefore, be sure to carry out a 3-point calibration the first time you use the probe. This will provide a default setting for the effect of temperature on your particular sensor. After this initial calibration, you can use the less time-consuming 2 point and 1-point routines to update the 3-point calibration. However, we strongly recommend a new 3-point calibration after each deployment of 30 days or longer.

(2) Ion selective electrodes may not stabilize as rapidly as pH sensors. Be sure to allow plenty of time for the readings to come to their final values during all calibration routines.

(3) Ion selective electrodes generally drift more than pH sensors. To check for this drift, place the sonde in one of your standards at the end of each deployment.

(4) Nitrate standards are good growth media for a variety of organisms. This growth can significantly reduce the nitrogen content of your standards, an effect that is particularly important for the 1 mg/L solution. It is best to use new standards for each deployment, but if you decide to save your solutions for reuse, we recommend refrigerated storage to minimize the growth of these organisms.

(5) Remember that the nitrate sensor will take longer to stabilize after exposure to pH buffers. To accelerate this process, soak the sensor in 100 mg/L standard for a few minutes after performing a pH calibration. In addition, be particularly careful that readings are stable during nitrate calibration after exposure to buffers.

CAUTION**:** *The nitrate membrane module is for use only at depths less than 50 feet (15.2 meters). Use of the probe at greater depths is likely to permanently damage the sensor***.**

5.9 AMMONIUM AND AMMONIA

The sonde ammonium probe employs a silver/silver chloride (Ag/AgCl) wire electrode in a custom filling solution. Nonactin membrane separates the internal solution from the sample medium and this membrane selectively interacts with ammonium ions. When the probe is immersed in water, a potential is established across the membrane that depends on the relative amounts of ammonium in the sample and the internal filling solution. This potential is read relative to the reference electrode of the sonde pH probe. As for all ISEs, there is a linear relationship between the logarithm of the ammonium activity (or concentration in dilute solution) and the observed voltage. The Nernst equation describes this relationship.

Under ideal conditions, the Nernst equation predicts a response of 59 mV for every 10-fold rise in ammonium activity at 25°C. In practice, however, empirical calibration of the electrode is necessary to establish an accurate slope of the response. Typical empirical slopes are 53-58 mV per decade for YSI sensors. This slope value is determined by calibration with two solutions of known ammonium concentration (typically 1 mg/L and 100 mg/L NH_4^+-N).

The slope of the plot of log (ammonium) vs. voltage is also a function of temperature. The slope changes by a factor that is the ratio of the absolute temperature of calibration to absolute temperature of measurement. The point where this new plot of log (ammonium) vs. voltage intersects the calibration plot is called the isopotential point. That is, the ammonium concentration at which changes in temperature cause no change in voltage. Our experience with ISEs indicates that for best accuracy, the isopotential point should be determined empirically. To do so, use a third calibration point where the voltage of the lower concentration standard is determined at a temperature at least 10°C different from the first two calibration points. The slope, offset, and isopotential point drift slowly, and the probe should be recalibrated periodically.

All ion selective electrodes are subject to interference from ions, which are similar in nature to the analyte. For example, sodium and potassium ions bind to the ammonium membrane and produce positive readings even when no ammonium is present. Fortunately, fresh water does not usually contain enough interfering ions to produce large errors. For example, a common conductivity for freshwater is about 1.2 mS/cm (Sal = 0.6). Even if the ionic content were due to sodium chloride, the ammonium reading would be erroneously high, about 0.4 mg/L.

However, brackish or seawater has enough sodium and potassium to cause interference so great as to make the sensor unsuitable for these media.

The sensor used in the sonde detects only ammonium ions (NH_4^+), the predominant form of total ammonium nitrogen in most environmental samples. However, using the concurrently determined values of pH, temperature, and conductivity, the sonde software can also provide the user with the concentration of free ammonia (NH_3) in the sample under investigation.

Ammonium ions and free ammonia are in equilibrium in any solution according to the following equation:

$$NH_4^+ \rightleftharpoons NH_3 + H^+$$

The value of the equilibrium constant associated with this reaction, $K = [NH_3][H^+]/[NH_4^+]$, and its variation with temperature and salinity, is well known. This information allows the free ammonia concentration $[NH_3]$ to be automatically calculated by the sonde software and displayed if this parameter is activated.

Despite the potential problems with interference when using ISEs, it is important to remember that almost all interfering species produce an artificially high ammonium reading. Thus, if the sonde indicates the presence of only small quantities of ammonium, it is unlikely that the reading is erroneously low because of interference. Unusually high ammonium readings (which could be due to interfering ions) should be confirmed by laboratory analysis after collection of water samples.

Of all the sensors available on the sonde, ion selective electrodes have the greatest tendency to exhibit calibration drift over time. This drift should not be a major problem for sampling studies where the instrument can be frequently calibrated. However, if an ammonium sensor is used in a longer-term deployment study with the sonde, the user should be aware that drift is almost certain to occur. The extent of the drift will vary depending on the age of the probe, the flow rate at the site, and the quality of the water. For all monitoring studies using ion selective electrodes, the user should acquire a few “grab samples” during the course of the deployment for analysis in the laboratory by chemical means or with another ammonium sensor which has been recently calibrated. Remember that the typical accuracy specification for the sensor (+/- 10 % of the reading or 2 mg/L, whichever is larger) refers to sampling applications where only minimal time has elapsed between calibration and field use.

CALIBRATION AND EFFECT OF TEMPERATURE

The ammonium sensor should be calibrated using solutions of known total ammonium-nitrogen content according to the procedures detailed in **Sections 2.6.1 and 2.9.2**. If a two point calibration protocol is used, the temperature of the standards should be as close as possible to that of the environmental medium to be monitored. The recommended calibration procedure is one involving three solutions. Two of the solutions should be at ambient temperature while the third should be at least 10 degrees Celsius different from ambient temperature. This protocol minimizes the effects of taking readings at temperatures that are significantly different ambient laboratory temperatures.

MEASUREMENT AND CALIBRATION PRECAUTIONS

(1) The temperature response of ion selective electrodes is not as predictable as that of pH sensors. Therefore, be sure to carry out a 3-point calibration the first time you use the probe. This will provide a default setting for the effect of temperature on your particular sensor. After this initial calibration, you can use the less time consuming 2 point and 1-point routines to update the 3-point calibration. However, we strongly recommend a new 3-point calibration after each deployment of 30 days or longer.

(2) Ion selective electrodes may not stabilize as rapidly as pH sensors. Be sure to allow plenty of time for the readings to come to their final values during all calibration routines.

(3) Ion selective electrodes generally drift more than pH sensors. To check for this drift, place the sonde in one of your standards at the end of each deployment.

(4) Ammonium standards are good growth media for a variety of organisms. This growth can significantly reduce the nitrogen content of your standards, an effect that is particularly important for the 1 mg/L solution. It is best to use new standards for each deployment, but if you decide to save your solutions for reuse, we recommend refrigerated storage to minimize the growth of these organisms.

(5) Remember that the ammonium sensor will take longer to stabilize after exposure to buffers in a sonde pH calibration. To accelerate this process, soak the sensor in 100 mg/L standard for a few minutes after performing a pH calibration. In addition, be particularly careful that readings are stable during ammonium calibration after exposure to buffers.

CAUTION**:** *The ammonium membrane module is for use only at depths less than 50 feet (15.2 meters). Use of the probe at greater depths is likely to permanently damage the sensor.*

5.10 CHLORIDE

The sonde chloride probe employs a solid state membrane attached to a conductive wire. When the probe is immersed in water, a potential is established across the membrane that depends on the amount of chloride in the medium. This potential is read relative to the reference electrode of the sonde pH probe. As for all ISEs, there is a linear relationship between the logarithm of the chloride activity (or concentration in dilute solution) and the observed voltage. The Nernst equation describes this relationship.

Under ideal conditions, the Nernst equation predicts a response of 59 mV for every 10-fold rise in chloride activity at 25°C. However, in practice, empirical calibration of the electrode is necessary to establish the slope of the response. Typical slopes are 45-55 mV per decade for YSI sensors. This slope value is determined by calibration with two solutions of known chloride concentration (typically 10 mg/L and 1000 mg/L Cl^-).

The slope of the plot of log (chloride) vs. voltage is also a function of temperature, changing from its value at calibration by a factor of the ratio of the absolute temperatures at calibration to that at measurement. The point where this new plot of log (chloride) vs. voltage intersects the calibration plot is called the isopotential point. That is, the chloride concentration at which changes in

temperature cause no change in voltage. Our experience with ISEs indicates that for best accuracy, the isopotential point should be determined empirically. To do so, the user employs a third calibration point where the voltage of the lower concentration standard is determined at a temperature at least 10°C different from the first two calibration points. The slope, offset and isopotential point drift slowly, and the probe should be recalibrated periodically.

All ion selective electrodes are subject to the interaction of species with the sensor membrane, which are similar in nature to the analyte. These interfering species thus include other halide ions (fluoride, bromide, and iodide) as well as other anions.

Despite the potential problems with interference when using ISEs, it is important to remember that almost all interfering species produce an artificially high chloride reading. Thus, if the sonde indicates the presence of only small quantities of chloride, it is unlikely that the reading is erroneously low because of interference. Unusually high chloride readings (which could be due to interfering ions) should be confirmed by laboratory analysis after collection of water samples.

Of all the sensors available on the sonde, ion selective electrodes have the greatest tendency to exhibit calibration drift over time. This drift should not be a major problem for sampling studies where the instrument can be frequently calibrated. However, if a chloride sensor is used in a longer-term deployment study with the sonde, the user should be aware that drift is almost certain to occur. The extent of the drift will vary depending on the age of the probe, the flow rate at the site, and the quality of the water. For all monitoring studies using ion selective electrodes, the user should acquire a few "grab samples" during the course of the deployment for analysis in the laboratory by chemical means or with another chloride sensor which has been recently calibrated. Remember that the typical accuracy specification for the sensor (+/- 15 % of the reading or 5 mg/L, whichever is larger) refers to sampling applications where only minimal time has elapsed between calibration and field use.

CALIBRATION AND EFFECT OF TEMPERATURE

The chloride sensor should be calibrated using solutions of known chloride content according to the procedures detailed in **Sections 2.6.1 and 2.9.2**. If a two point calibration protocol is used, the temperature of the standards should be as close as possible to that of the environmental medium to be monitored. The recommended calibration procedure is one involving three solutions. Two of the solutions should be at ambient temperature while the third should be at least 10 degrees Celsius different from ambient temperature. This protocol minimizes the effects of taking readings at temperatures that are significantly different ambient laboratory temperatures.

MEASUREMENT AND CALIBRATION PRECAUTIONS

(1) The temperature response of ion selective electrodes is not as predictable as that of pH sensors. Therefore, be sure to carry out a 3-point calibration the first time you use the probe. This will provide a default setting for the effect of temperature on your particular sensor. After this initial calibration, you can use the less time-consuming 2 point and 1-point routines to update the 3-point calibration. However, we strongly recommend a new 3-point calibration after each deployment of 30 days or longer.

(2) Ion selective electrodes may not stabilize as rapidly as pH sensors. Be sure to allow plenty of time for the readings to come to their final values during all calibration routines.

(3) Ion selective electrodes generally drift more than pH sensors. Be sure to check for this drift by placing the sonde in a standard at the end of each deployment.

(4) Remember that the chloride sensor will take longer to stabilize after exposure to pH buffers. To accelerate this process, soak the sensor in 1000 mg/L standard for a few minutes after performing a pH calibration. In addition, be particularly careful that readings are stable during chloride calibration after exposure to buffers.

5.11 TURBIDITY

Turbidity is the measurement of the content of suspended solids (cloudiness) in water and is typically determined by shining a light beam into the sample solution and then measuring the light that is scattered off of the particles which are present. For turbidity systems capable of field deployment, the usual light source is a light emitting diode (LED) which produces radiation in the near infrared region of the spectrum. The detector is usually a photodiode of high sensitivity. The angle between the emitted and detected light varies (usually between 90 and 180 degrees) depending on the probe used. The International Standards Organization (ISO) recommends the use of a light source with a wavelength between 830 and 890 nm and an angle of 90 degrees between the emitted and detected radiation (ISO 7027).

The turbidity system available as an option for use with the sonde consists of a probe which conforms to the above ISO recommendations. The output of the sonde turbidity sensor is processed via the sonde software to provide readings in nephelometric turbidity units (NTUs).

Two probes are available for use with the sonde. The YSI 6026 is equipped with a mechanical wiper to periodically clean the sensor either by manual or automatic activation. This probe is designed for long term monitoring, but also works well for spot sampling applications.

The YSI 6036 has no mechanical wiper and thus dimensionally has a shorter profile. The 6036 works well for spot sampling, but is not recommended for long term monitoring applications. Its advantages include lower initial cost and the fact that the user can employ a shorter probe guard and storage cup (available as optional accessories).

Field optical measurements are particularly susceptible to fouling, not only from long term build up of biological and chemical debris, but also to shorter term formation of bubbles from outgassing of the environmental water. These bubbles can generally be removed in short term sampling application by simply agitating the sonde manually. However, for studies longer than a few hours where the user is not present at the site, the quality of the turbidity data obtained with a turbidity sensor that has no capability of mechanical cleaning (e.g., the 6036) is likely to be poor. However, as noted above, the 6026 probe is equipped with a mechanical wiper that makes it ideal for unattended applications. The wiper can be activated in real-time during discrete sampling operations or will function automatically during long term unattended sampling studies. The number of wiper movements and the frequency of the cleaning cycle for the unattended mode can be set in the sonde software. Generally one movement is sufficient for

most environmental application, but in media with particularly heavy fouling, additional cleaning cycles may be necessary.

CALIBRATION AND EFFECT OF TEMPERATURE

The sonde software offers the option of 1 point, 2 point, or 3 point calibrations procedures. For most applications, a 2-point calibration at 0 and 100 NTU is sufficient. However, because the calibration curve of the system exhibits a small nonlinearity below 10 NTU, a 3 point calibration at values of 0, 10 and 100 NTU can be carried out to provide maximum accuracy over the normally encountered environmental turbidity range (0-1000 NTU). Although a 1000 NTU calibration would be ideal, the sensor is extremely linear between 100 and 1000 NTU and, because of the cost of the reagents, the benefit of use of the higher standard is not significant. If the range of turbidity in the environmental sample is well known, standards of other turbidity values can be utilized (in either 3 point or 2 point routines). However, one of the standards must be 0 NTU. Note that, for all calibration procedures, it is very important that the standards used in the calibration should be based on either formazin or AMCO-AEPA styrene divinylbenzene beads as described in *Standard Methods for the Examination of Water and Wastewater*. Use of standards prepared from other materials may result in spurious and inaccurate readings. Note that YSI offers 100 NTU turbidity calibrant as a standard product (6073) and that this standard can be quantitatively diluted with turbidity-free water to provide a 10 NTU calibrant suspension.

The overall sensitivity (slope) of the optical sensor is generally less susceptible to drift than its offset (probe output at 0 NTU). The 1 point calibration is designed to reset this offset without affecting the slope and thus provide more accurate performance in water of low turbidity. Usually, the 1 point calibration should be done at 0 NTU, but the sonde software will accept any value in the turbidity range of the instrument (0-1000 NTU)

While the effect of temperature on the turbidity sensor is small (approximately 0.3 % per °C), this factor is automatically taken into account by the sonde software providing temperature compensated readings. However, all sensors have slightly different temperature factors and thus to obtain the maximum accuracy in your readings, we recommend calibration at a temperature as close as possible to that of the environmental sample.

MEASUREMENT AND CALIBRATION PRECAUTIONS

(1) For best results, use only freshly prepared turbidity standards. Under some conditions, degradation of standards can occur on standing particularly at lower (less than 20 NTU) values.
(2) If unusually high or jumpy readings are observed during the calibration protocol, it is likely that there are bubbles on the optics. Manually moving the sonde (up/down and back/forth) usually removes these bubbles. If the probe is a 6026, the surface can be cleaned by manually activating the wiper prior to each calibration input.

(3) The output of turbidity sensors is susceptible not only to the overall cloudiness of the environmental medium, but also to the particle size of the suspended solids which pass across the optics on the probe face. Thus, although the turbidity of an environmental sample may appear to the eye to be relatively stable, the displayed turbidity can vary significantly depending on the nature of the particles in the optical path at the instant of measurement. For example, if individual readings are taken every 4 seconds in a discrete sample study of environmental water,

variations of 0.5-1.0 NTU are common between readings. In long term, unattended studies this effect can be even more exaggerated with spikes of up to 10 NTU sometimes observed. This apparent jumpiness is not observed for freshly prepared turbidity standards, since the particle size in these suspensions is homogeneous.

The sonde turbidity system allows the user to either observe these real turbidity events (while obtaining somewhat jumpy readings) or to apply a mathematical filter to the raw data so that the NTU output may be more reflective of the overall cloudiness of the environmental sample. From the 8-Advanced menu of the sonde software, the user can activate the data filter specific to turbidity and "fine tune" its performance. For typical sampling and monitoring applications, YSI recommends that the Data Filter settings be selected as follows: Enabled -- On; Wait for Filter -- Off; Time Constant = 12; Threshold = 0.010.

For most unattended sampling applications, selection of the above filter settings should also be appropriate. However, an additional capability is also available which enhances the elimination of spurious single point spikes from the logged data and thus allows for a better presentation of the average turbidity during the deployment. This "**Turb Spike Filter**" is activated/deactivated in the **3-Sensor** submenu of the **Advanced** menu. Its capability is further described in **Section 2.9.8, Advanced**. YSI recommends the use of this feature for all unattended studies. The user should determine from experience whether its activation is also appropriate for spot sampling studies at particular sites.

See **Appendix E, Turbidity Measurements** for additional practical information on the measurement of turbidity with the sonde.

5.12 CHLOROPHYLL

INTRODUCTION

Chlorophyll, in various forms, is bound within the living cells of algae, phytoplankton, and other plant matter found in environmental water. Chlorophyll is a key biochemical component in the molecular apparatus that is responsible for photosynthesis, the critical process in which the energy from sunlight is used to produce life-sustaining oxygen. In general, the amount of chlorophyll in a collected water sample is used as a measure of the concentration of suspended phytoplankton, the magnitude of which can significantly affect the overall quality of the water.

The use of the measurement of phytoplankton as an indicator of water quality is described in Section 10200 A. of *Standard Methods for the Examination of Water and Wastewater*. The classical method of determining the quantity of chlorophyll at a particular site is to collect a fairly large water sample and analyze it in the laboratory. The procedure involves filtration of the sample to concentrate the chlorophyll containing organisms, mechanical rupturing of the collected cells, and extraction of the chlorophyll from the disrupted cells into the organic solvent, acetone. The extract is then analyzed by either a spectrophotometric method using the known optical properties of chlorophyll or by high performance liquid chromatography (HPLC). This general method is detailed in Section 10200 H. *of Standard Method* and has been shown to be accurate in multiple tests and applications as long as a competent laboratory analyst carries out the protocol. The procedure is generally accepted for reporting in scientific literature. The

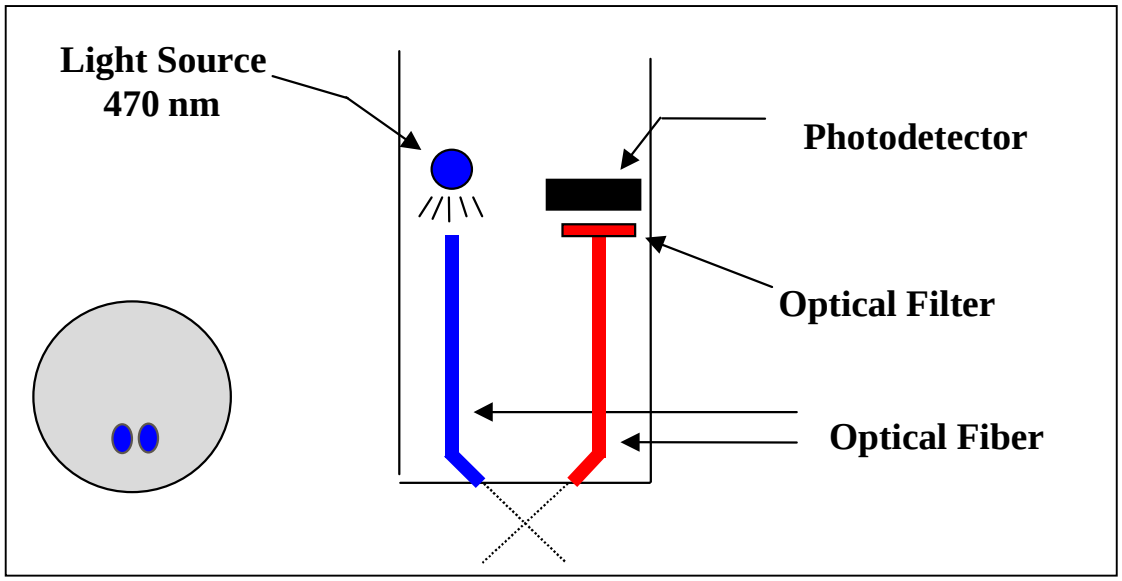
method is time-consuming, however, and usually requires an experienced, efficient analyst to generate consistently accurate and reproducible results. It also does not lend itself readily to continuous monitoring of chlorophyll, and thus phytoplankton, since the collection of samples at reasonable time intervals, e.g., every hour, would be extremely tedious.

YSI has developed the YSI 6025 chlorophyll sensor for the determination of chlorophyll in spot sampling and continuous monitoring applications. It is based on an alternative method for the measurement of chlorophyll which overcomes these disadvantages, albeit with the potential loss of accuracy. In this procedure, chlorophyll is determined *in situ,* i.e., without disrupting the cells as in the extractive analysis. The YSI 6025 chlorophyll sensor is designed for these *in situ* applications and its use allows the facile collection of large quantities of chlorophyll data in either spot sampling or continuous monitoring applications. It is important to remember, however, that the results of *in situ* analysis will not be as accurate as those from the certified extractive analysis procedure.

The limitations of the *in situ* method are outlined below and should be carefully considered before making chlorophyll determinations with your YSI sonde and sensor. Some of the sources of inaccuracy can be minimized by combining the data from the YSI 6025 with data from extractive analysis of a few samples acquired during a sampling or monitoring study. However, the *in situ* studies will never replace the standard procedure. Rather, the estimates of chlorophyll concentration from the easy-to-use YSI chlorophyll system are designed to complement the more accurate (but more difficult to obtain) results from more traditional methods of chlorophyll determination.

MEASUREMENT OF CHLOROPHYLL *IN SITU*

One key characteristic of chlorophyll is that it fluoresces, that is, when irradiated with light of a particular wavelength, it emits light of a higher wavelength (or lower energy). The ability of chlorophyll to fluoresce is the basis for all commercial fluorometers capable of measuring the analyte *in situ*. Fluorometers of this type have been in use for some time. These instruments induce chlorophyll to fluoresce by shining a beam of light of the proper wavelength into the sample, and then measuring the higher wavelength light which is emitted as a result of the fluorescence process. Most chlorophyll systems use a light emitting diode (LED) as the source of the irradiating light that has a peak wavelength of approximately 470 nm. LEDs with this specification produce radiation in the visible region of the spectrum with the light appearing blue to the eye. On irradiation with this blue light, chlorophyll resident in whole cells emits light in the 650-700 nm region of the spectrum. To quantify the fluorescence the system detector is usually a photodiode of high sensitivity that is screened by an optical filter that restricts the detected light. The filter prevents the 470 nm exciting light from being detected when it is backscattered off of particles in the water. Without the filter, turbid (cloudy) water would appear to contain fluorescent phytoplankton, even though none were present. The following diagram can be used to better understand the principles of the YSI system.



Most commercial fluorometers fit into two categories. The first category is benchtop instruments that generally have superior optical flexibility and capability but are relatively expensive and are often difficult to use in the field. The second category is sonde-type fluorometers that have a fixed optical configuration but are less expensive, can be more easily used in the field, and are usually compatible with data collection platforms. The use of a pump is generally recommended for sonde fluorometers and this can result in the need for large capacity batteries for field use.

The unique YSI chlorophyll system available as an option for use with YSI sondes consists of a probe which is similar in concept to the sonde-type fluorometers, but is much smaller, making it compatible with the probe ports of the YSI 6820, 6920, and 6600 sondes. The output of the sensor is automatically processed via the sonde software to provide readings in either generic fluorescence units (percent full scale; % FS) or µg/L of chlorophyll. No pump is required for the YSI system allowing the sensor to operate off of either the sonde internal batteries or the batteries in the YSI 610 display/logger. Like the widely-used YSI 6026 turbidity probe, the YSI 6025 chlorophyll probe is equipped with a mechanical wiper to periodically clean the optical face either by manual or automatic activation. With these features, the YSI chlorophyll sensor provides the same level of performance as the sonde fluorometers, but is much easier to use and can be deployed in environmental water for several weeks without the need for service. In addition, the probe will be a component in sondes that can acquire up to ten other parameters simultaneously with chlorophyll, rather just providing the single parameter.

CALIBRATION METHODS -- GENERAL

As described in **Section** 2 of this manual, the sonde software offers the option of either zeroing the generic fluorescence parameter (% FS) or of performing 1-point, 2-point, or 3-point calibration procedures in µg/L of chlorophyll. For most applications, a 2-point calibration at 0 and middle range (e.g., 150 µg/L) is sufficient. Slight non-linearities of the system can be overcome with a 3-point calibration across the normally encountered environmental chlorophyll range (0-400 µg/L). If the range of chlorophyll content in the environmental sample is well

known, standards of any chlorophyll values can be utilized in either 3-point or 2-point routines. However, one of the standards must be 0 µg/L.

For calibration of the YSI chlorophyll system, two formulations of standards can be produced by the user. The first, and more accurate, of these standards is a phytoplankton suspension whose chlorophyll content has been determined by the extractive analysis procedure described in *Standard Methods*. A variation of this method is a phytoplankton suspension that has been analyzed *in situ* using a bench fluorometer. The second and easier to prepare and use of the standards is a very dilute solution of a dye that emits detectable fluorescence under the optical constraints of the sensor. It is important to remember that the use of any dye standard is likely to be significantly less accurate than using samples of algae whose chlorophyll has been determined by extractive analysis. The dye standard method should only be used as an approximation that can be confirmed or adjusted later using the extractive analysis results from grab samples acquired during the study. However, the use of a dye standard is very useful in assuring the overall optical stability of the chlorophyll sensors in post-study quality control procedures.

A solution of Acridine Orange can be used to provide an approximate default sensitivity to the YSI 6025 chlorophyll sensor for *in situ* measurements. The standard can be prepared as described in the next section.

ACRIDINE ORANGE STANDARD SOLUTION – PREPARATION AND USE

***CAUTION*: Acridine Orange is listed as a possible mutagen and suitable protective clothing should be worn during its handling. Be certain to read the safety instructions provided by the supplier with this chemical before preparing solution standards from the solid material. Remember that only trained personnel should handle chemicals.**

PREPARATION

Use the following procedure to prepare an Acridine Orange solution that will roughly correlate with *in situ* chlorophyll values:

1. Acridine Orange is a commonly used dye/marker reagent and can be purchased from chemical supply houses such as Sigma/Aldrich. Purchase the minimum quantity possible since only very dilute solutions of the dye will be required. The following solutions were prepared from Acridine Orange Hydrochloride, Hydrate (Sigma item # A 4921).

2. Accurately weigh 0.0500 g of the Acridine Orange and quantitatively transfer the solid to a 500-mL volumetric flask. Dissolve the solid in purified (distilled or deionized) water, add 20 mL of 1-M hydrochloric acid as a stabilizer, and then fill the flask to the top graduation. This solution contains 100 mg of Acridine Orange per 1000 mL of water. **(*CAUTION*: Be certain to follow the supplier's warnings when using hydrochloric acid.)**

3. Accurately transfer 2.0 mL of the solution prepared in the above step to a 1000 mL volumetric flask, add 20 mL of 1M hydrochloric acid as a stabilizer, and then fill the flask to the top graduation with purified water. Mix well to obtain a solution that is 0.20 mg/L in water (a

500:1 dilution of the concentrated solution). **(*CAUTION*: Be certain to follow the supplier's warnings when using hydrochloric acid.)**

4. Store the concentrated standard solution in a darkened glass bottle in a refrigerator to retard decomposition. The dilute standard prepared in the previous step should be used within 4 hours of its preparation.

When Acridine Orange standards are required in the future, perform another dilution of the concentrated dye solution after warming it to ambient temperature. Our experience has indicated that the concentrated solution that has been kept at cold temperatures is much more stable than the dilute solution stored at room temperature.

USE

It is well known that the intensity of the fluorescence of many dyes shows an inverse relationship with temperature. The effect must also be accounted for when calibrating the YSI chlorophyll sensor with Acridine Orange. To properly set the sensitivity of the sensor toward algae at 20 °C using the 0.2 mg/L Acridine Orange standard, enter the calibration value from the table below corresponding to the temperature of the standard.

WARNING: The "Chl Tempco" factor in the Advanced|Sensor menu, MUST BE SET TO ZERO, when calibrating with Acridine Orange.

The following table shows an approximate phytoplankton chlorophyll equivalent of 0.2 mg/L Acridine Orange dye as a function of temperature.

°C	µg/L Chl to Enter	° C	µg/L Chl to Enter
30	119	18	153
28	126	16	158
26	133	14	162
24	139	12	165
22	143	10	170
20	148	8	173

CAUTION: The calibration with acridine orange is only an approximation. Due to inherent inaccuracy in the *in situ* method described below, the user should always relate the field fluorescence readings taken with the YSI 6025 probe to data from extractive analysis samples. YSI does not provide an accuracy specification for chlorophyll due to these limitations.

EFFECT OF TEMPERATURE ON READINGS

While the effect of temperature on the chlorophyll sensor itself is very small, YSI experiments have indicated that the fluorescence of phytoplankton suspensions can show significant temperature dependence. For example, the apparent chlorophyll content of our laboratory test samples of algae increased from 185 to 226 µg/L when the temperature was dropped from 21 °C to 1 °C even though no change in phytoplankton content took place. In the absence of

compensation, this effect would obviously result in errors in field chlorophyll readings if the site temperature were significantly different from the calibration temperature. This temperature error can be reduced by employing a chlorophyll temperature compensation routine ("Chl tempco") resident in the sonde software under the Advanced|Sensor menu.

From our studies, it appears that entry of a value of 1 to 2 % per degree C for "Chl tempco" is appropriate to partially account for changes in the fluorescence of environmental phytoplankton with temperature. This value can be estimated in the above example as follows:

Change in Temperature = 21–1 = 20 °C
Change in Fluorescence = 226-185 = 41 µg/L
% Change in Fluorescence = (41/185) x 100 = 22.1
Chl Tempco Factor = 22.1/20 = 1.11 % per degree °C

Note that the use of this empirically derived compensation does not guarantee accurate field readings since each species of phytoplankton is likely to be unique with regard to the temperature dependence of its fluorescence. Changes in fluorescence with temperature are a key limitation of the *in situ* fluorometric method (see below) which can only be reduced, not eliminated, by this compensation. In general, the best way to minimize errors is to calibrate with phytoplankton standards of known chlorophyll content that are as close as possible in temperature to that of the environmental water under investigation.

EFFECT OF FOULING ON OPTICAL MEASUREMENTS

Field optical measurements are particularly susceptible to fouling, not only from long term build up of biological and chemical debris, but also to shorter term formation of bubbles from outgassing of the environmental water. These bubbles can sometimes be removed in short term sampling applications by simply agitating the sonde manually. For studies longer than a few hours where the user is not present at the site, the quality of the chlorophyll data obtained with a fluorescence sensor that has no capability of mechanical cleaning is likely to be compromised. The YSI 6025 probe is equipped with a mechanical wiper that makes it ideal for unattended applications. The wiper can be activated in real-time during discrete sampling operations or will function automatically just before each sample is taken during long term unattended monitoring studies. The number of wiper movements and the frequency of the cleaning cycle for the unattended mode can be set in the sonde software. Generally, one wiper movement is sufficient for most environmental applications, but in media with particularly heavy fouling, additional cleaning cycles may be necessary.

EFFECT OF TURBIDITY ON CHLOROPHYLL READINGS

As described above, the filters in front of the photodiode in the YSI 6025 chlorophyll probe prevent most of the 470 nm light which is used to excite the chlorophyll molecules from reaching the detector after being backscattered off of non-fluorescent particles (turbidity) in environmental water. However, the filter system is not perfect and a minor interference on chlorophyll readings from suspended solids may result. Laboratory experiments indicate that a suspension of typical soil measured with a YSI 6026 sensor will have a turbidity interference characterized by a factor of about 0.03 µg/L per NTU. For example, the turbidity of the water must be above 100 NTU to produce an apparent chlorophyll reading equal to 3 µg/L. In very

cloudy water, the user may wish to use the independently-determined turbidity value and the above compensation factor to correct measured chlorophyll values using, for example, a spreadsheet.

LIMITATIONS OF *IN SITU CHLOROPHYLL* MEASUREMENTS

As noted above, the measurement of chlorophyll from *in situ* fluorescence measurements will always be less reliable than determinations made on molecular chlorophyll that has been extracted from the cells using the procedures described in *Standard Methods*. This section describes some of the known problems with *in situ* chlorophyll measurement.

INTERFERENCES FROM OTHER FLUORESCENT SPECIES: The analytical methods described in *Standard Methods* for chlorophyll involve disruption of the living organisms present in suspension, followed by extraction of molecular chlorophyll into a homogeneous solution in an organic solvent. Acidification of the extract helps to minimize the interferences caused by a number of other, non-chlorophyll species. In addition, readings can be taken at various wavelengths on a spectrophotometer to differentiate between the various forms of chlorophyll (a, b, c) and pheophytin a.

In contrast to this fairly controlled situation, all *in situ* sensors operate under whole-cell, heterogeneous conditions where the sensor will measure, at least to some degree, everything which fluoresces in the region of the spectrum above 630 nm when irradiated with 470 nm light. Therefore, the sensor is really quantifying overall fluorescence under these optical conditions, rather than chlorophyll specifically. While it is probable that most of the fluorescence is due to suspended plant and algal matter and that much of the fluorescence from this biomass is due to chlorophyll, it is impossible to exclude interferences from other fluorescent species using the approach described above.

Note that *in situ* fluorometers usually cannot differentiate between the different forms of chlorophyll.

LACK OF CALIBRATION REAGENTS: The usual reagents which are used for the calibration of fluorometric measurements for chlorophyll after extraction into organic solvents are purchased as “purified chlorophyll a” from chemical supply vendors such as Sigma. These standards are not soluble in aqueous media and, even if they were, their fluorescence is unlikely to be the same as when the chlorophyll is present in the whole living cell. Therefore, for even a semiquantitative calibration, the user needs a “substitute” standard such as Acridine Orange (see above) to provide a method for estimating the sensitivity of the sensor. Field readings based on this type of calibration will provide only an estimate of chlorophyll in environmental water where the measurement is taken on whole cell suspensions *in situ*. The calibration standard that provides the best measure of accuracy for *in situ* chlorophyll sensors is a portion of a phytoplankton suspension that has been analyzed for chlorophyll by the extractive procedure. We recommend the use of this procedure and further recommend that the phytoplankton suspension be taken from the site being monitored so that the species producing the fluorescence in the standard are as close as possible to the field organisms. To truly assess data reliability in a long term monitoring study, grab samples should be taken periodically, e.g. weekly, and analyzed in the laboratory as the study progresses. These data can then be used to “postcalibrate” the readings logged to the instrument during the study, perhaps using a spreadsheet for the simple mathematical treatment. In any case, getting quantitative chlorophyll data from any *in situ* fluorometric sensor is much more difficult than with most other environmental sensors. For this reason, it is difficult to provide an accuracy specification for

chlorophyll measurement made with *in situ* fluorometers and therefore no accuracy specification is quoted for the YSI 6025.

EFFECT OF CELL STRUCTURE, PARTICLE SIZE, AND ORGANISM TYPE ON *IN SITU READINGS*: Even if the only fluorescent species present for *in situ* measurements were chlorophyll, and reliable calibration standards were available, its absolute quantification would probably still be difficult because samples are not homogeneous. Differing species of algae with differing shape and size will likely fluoresce differently even if the type and concentration of chlorophyll are identical and this significantly limits the accuracy of *in situ* measurements.

EFFECT OF TEMPERATURE ON PHYTOPLANKTON FLUORESCENCE: As noted above, YSI experiments indicate that phytoplankton fluorescence increases as temperature decreases. Thus, readings taken on a phytoplankton suspension at cold temperature would erroneously indicate the presence of more phytoplankton than when the suspension is read at room temperature. Unless this effect is taken into account, most field readings will be somewhat in error, since the field temperature will differ from the temperature of calibration. The use of the "Chl Tempco" factor found in the Advanced|Sensor menu will help to reduce this error, but must be used with caution since each species of phytoplankton is likely to have a slightly different temperature dependence.

EFFECT OF PHOTOSYNTHETIC ACTIVITY ON PHYTOPLANKTON FLUORESCENCE: Chlorophyll is a key factor in the photosynthetic apparatus of phytoplankton, participating in the production of oxygen during the day and "resting" at night during the respiration cycle of the cells. It seems likely that the fluorescence of the phytoplankton will vary in intensity depending on the state of the chlorophyll. Empirical data indicate that, at constant phytoplankton level, the fluorescent signal can change significantly on a diurnal schedule, showing less fluorescence when oxygen is being produced and more fluorescence during the "resting" phase of the organisms. If further data supports this hypothesis, it is clear that this effect would produce errors in the absolute values of chlorophyll unless it was accounted for by the user.

The chlorophyll section of Standard Methods substantiates these limitations, and application notes that are offered by current fluorometer manufacturers. The limitations result in the realization that any *in situ* "chlorophyll" sensor will be much less quantitative than any of the other sensors offered for use with our sondes.

MEASUREMENT AND CALIBRATION TIPS

(1) For best results, use only freshly analyzed or prepared chlorophyll standards.

(2) If unusually high or jumpy readings are observed during calibration, it is likely that there are bubbles on the optics. The surface should be cleaned by manually activating the wiper before confirming the calibration.

(3) The output of the YSI fluorescence sensor is susceptible not only to the overall phytoplankton concentration in the environmental medium, but also to the size and rate of movement of the suspended particles that pass across the optics on the probe face. Thus, although the phytoplankton content of an environmental sample may appear to the eye to be

relatively stable, the displayed chlorophyll reading can vary significantly depending on the nature of the particles in the optical path at the instant of measurement. In a discrete sample study of environmental water, for example, the variability of the output can be significant. This apparent jumpiness is not observed in dye standards, since these are homogeneous solutions containing no suspended matter.

The sonde chlorophyll system allows the user to apply a mathematical filter to the raw data so that the sensor output may be more representative of the average phytoplankton content of the environmental sample. From the 8-Advanced menu of the sonde software, the user can activate the data filter and adjust its performance. For typical sampling and monitoring applications, YSI recommends that the Data Filter settings for chlorophyll be selected as follows: Enabled -- On; Wait for Filter -- Off; Chlorophyll Time Constant = 12; Chlorophyll Threshold = 1. The advantage of the filter is a more stable display of chlorophyll readings.

The above filter settings are also appropriate for most unattended sampling applications. However, an additional capability is also available which enhances the elimination of spurious single point spikes from the logged data and thus allows for a better presentation of the average chlorophyll during the deployment. This "**Chl Spike Filter**" is activated/deactivated in the Advanced|Sensor menu. Its capability is further described in **Section 2.9.8, Advanced**. The user should determine from experience whether its activation is appropriate for spot sampling and/or monitoring studies at particular sites.

5.13 FLOW

Flow is a calculated value. Whenever there is a one to one relationship between the level of water in an open channel and the flow of water through it, then flow can be calculated from a level measurement. YSI sondes that are equipped with shallow vented level can calculate flow based on several different methods.

Flow is only available in the Sensors menu on those sondes that have shallow vented level. The **Flow Setup** menu only appears when **Flow** is enabled in the **Sensors** menu.

Note: In this manual we describe how to use our sondes to calculate flow from vented level. While weirs, flumes and the Manning equation are described briefly in this manual, it is not a complete treatment of the subject. We make no claims on the accuracy or appropriateness of any of these techniques for any particular application.

WEIR AND FLUME

Many devices have been designed for the determination of flow in an open channel. For example, a weir is a dam of specific geometry that restricts the flow of water while giving a very repeatable and accurate relationship between level and flow. There are several varieties of weirs; each designed for a specific application. Similarly, a flume also restricts flow producing a repeatable and accurate flow/level curve by forcing the flow not over a dam, but through a narrower portion of the channel. The flow is gradually narrowed, passed through a throat in the channel, and then gradually expanded back to the original channel width. As with weirs, there are several varieties of flumes, each designed for a specific application.

The weir or flume is referred to as the primary measuring device, and the level meter is referred to as the secondary measurement device. There are commonly 3 types of weirs and 7 types of flumes. Most of these are available in a number of sizes. Flow/level curves for common types and sizes are already programmed in the sonde so that it is only necessary to describe the primary measuring device to get flow readings. If you have a primary measuring device that is not already programmed, you have the option of entering either an equation or a table that defines the flow/level curve for your device. The table can also be used to calculate the flow of water in stream for which the flow/level data is available.

MANNING EQUATION

YSI sondes with shallow vented level can be used with the Manning equation. In an open channel without any restriction built explicitly for measuring flow, the Manning Equation can sometimes be used to calculate flow. Under the right conditions the channel itself is the primary measurement device and flow can be calculated from the level of water in the channel. Careful use of the Manning equation under ideal conditions can be accurate to 10%. Less careful use under worse conditions can give errors of 50% or more. The formula is:

$$Q = \frac{K \bullet A \bullet R^{\frac{2}{3}} \bullet S^{\frac{1}{2}}}{n}$$

Where: Q = Flow rate
A = Cross sectional area of flow
R = Hydraulic radius
S = slope
n = Manning coefficient of roughness
K = constant dependent on units

The Manning roughness coefficient n is an index of the frictional resistance to flow on the surface of the channel. Values of n are published for different materials. However, in the field, determination of n is perhaps the largest source of error. For example, n for a concrete channel can vary from 0.011 to 0.020 depending upon how the surface of the concrete was finished during construction. Occasional debris or vegetation in the channel also affects the value of n, and in most applications the value changes depending upon the depth of water in the channel.

Other uncertainties can also make the measurement inaccurate. Best results are obtained at the end of a straight channel 1000 feet (300 meters) long. However, in reality it is difficult to find channels that are very long, and very straight, and with constant slope, and with uniform roughness.

Even with all these uncertainties, the Manning equation can yield useful results as long as the user is aware of its limitations.

EQUATION

The YSI sondes that are equipped with shallow vented level can also calculate flow based on an equation. The equation must be of the form:

$$Q = K_1 \bullet H^{P_1} + K_2 \bullet H^{P_2}$$

This allows the use of primary measuring devices other than the standard ones already programmed. Users may enter values for K_1, P_1, K_2, and P_2 and the sonde will calculate flow. Note: if you do not need the second term in the equation, simply enter 0 for K_2.

TABLE

YSI sondes that are equipped with shallow vented level can also calculate flow based on a table. Users can enter up to 50 pairs of (level, flow) data. The sonde will then calculate flow from the resulting table, linearly interpolating between points when necessary. This feature can be used with non-standard primary measuring devices for which there is a table rather than an equation. This data is often available for rivers and streams so that flow can be calculated from the level in a river at the proper location.

See Appendix F, Flow for additional practical information on the calculation of flow with a sonde.

SECTION 6 TROUBLESHOOTING

This section contains troubleshooting tables that will be helpful to identify the causes of the most common difficulties that may occur while operating the YSI 6-Series Sondes. The **Symptom** column describes the type of difficulty that you might experience. The **Possible cause** column describes the conditions that might cause the stated symptom. The **Action** column provides simple steps that can be followed to correct for the "possible cause" and cure the "symptom" being experienced. The column entitled **Ref** is the number of the reference section and subsection in the manual where you may find additional information.

Troubleshooting problems have been categorized into four general areas.

- Calibration Error Messages
- Sonde Communication
- Sensor Performance

If you need assistance that this Troubleshooting section can not provide, please contact YSI or your authorized dealer. See **Appendix C, Accessories and Calibration Standards**, for specific contact information.

6.1 CALIBRATION ERRORS

There are only three Calibration Error messages that are possible and are listed below, instead of in the troubleshooting table. Only two of the error messages are related to sensor performance.

High DO Charge: This message indicates a malfunction in the DO sensor that is generally due to the roughness of the electrodes on the surface of the probe face. The charge associated with the DO sensor must be in the range 25 to 100 or the error message will appear when calibration is attempted. If this error message is encountered, remove the DO probe from the sonde and resurface it according to the instructions in **Section 2.10, Care, Maintenance and Storage**. After resurfacing the probe, activate the DO charge parameter in the Report setup section of the sonde software and confirm that the value is within the acceptable range. After resurfacing, allow the sensor to pulse in the Run mode for at least 5 minutes, during which time the DO charge may be expected to drop in value if the sensor is still functional. If resurfacing according to the instructions in **Section 2.10, Care, Maintenance and Storage** does not result in a lowering of the charge, contact YSI Customer Service for additional help.

Out of Range: This message indicates that the output of the sensor being calibrated does not conform to the normal range for this parameter. This problem could be due to either a malfunctioning sensor or to a calibration solution that is out of specification. If this error message is encountered, first insure that your standards for pH, ORP, ammonium, nitrate, chloride, conductivity, and turbidity have not been contaminated and that your DO sensor is in air (DO % Cal) or in a solution of known dissolved oxygen concentration (DO mg/L). Also be certain that you have entered the correct value for the calibration solution. If the calibration error message continues to occur, contact YSI Customer Service to determine whether the sensor in question needs to be factory-serviced or replaced.

Illegal Entry: This message simply indicates that your keyboard input does not conform to the accepted format for this parameter. For example, you may have entered the "letter O" instead of "zero" for a calibration value. Return to the desired parameter in the Calibrate menu and repeat the calibration entry, being certain to enter only numbers.

The following troubleshooting tables can help you if you encounter problems with software, communication protocol, or sensor malfunctions other than calibration errors.

6.2 SONDE COMMUNICATION PROBLEMS

SYMPTOM	POSSIBLE CAUSE	ACTION	REF
Cannot communicate with sonde	Sonde not powered	Check 12 vdc source	7.2
	Cable connection is loose	Check both ends of cable; secure connectors	
	Damaged connectors	Check pins at both ends, insure they are straight, dry and clean.	
	Com port not selected	Change to other com port, other peripheral on the same port (Internal mouse). Try other PC, 610 display/logger or dumb terminal	2.4.3
Scrambled data	Unmatched baud rate between host and sonde	Match the baud rate	2.4.3
	Host is too slow	Use faster computer	
	Interface cable failure	Check cable for damage. If necessary, return for service	7
	Internal failure	Return sonde for service	7

6.3 SENSOR PERFORMANCE PROBLEMS

SYMPTOMS	POSSIBLE CAUSE	ACTION	REF
Dissolved Oxygen reading unstable or inaccurate	Probe not properly calibrated	Follow DO cal procedures	2.6.1
	Membrane not properly installed or may be punctured	Follow 6562 setup procedure	2.3.1
	DO probe electrodes require cleaning	Follow DO cleaning procedure. Use 6035 maint. kit	2.10.2
	Water in probe connector	Dry connector; reinstall probe	2.3.2
	Algae or other contaminant clinging to DO probe	Rinse DO probe with clean water	2.10.2
	Barometric pressure entry is incorrect	Repeat DO cal procedure	2.6.1
	Cal at extreme temperature	Recal at (or near) sample temperature	2.6.1
	DO Charge too high (>100) 1. Anodes polarized (tarnished) 2. Probe left on continuously	Enable DO charge parameter in the Sonde report menu. Run sonde, if charge is over 100, recondition probe with 6035 Maintenance Kit. Follow DO cleaning procedure.	2.7 2.7 2.10.2
	DO Charge too low (<25) Insufficient electrolyte.	Replace electrolyte and membrane.	2.3.1
	DO probe has been damaged	Replace 6562 probe	8/C
	Internal failure	Return sonde for service	8
pH, ORP, chloride, ammonium, or nitrate readings are unstable or inaccurate. Error messages appear during calibration.	Probe requires cleaning,	Follow probe cleaning procedure	2.10.2
	Probe requires calibration	Follow cal procedures	2.6.1 3.7.4
	pH probe reference junction has dried out from improper storage.	Soak probe in tap water or buffer until readings become stable	2.10.2
	Water in probe connector	Dry connector; reinstall probe	2.3.2
	Probe has been damaged	Replace probe	8/C
	Calibration solutions out of spec or contaminated with other solution	Use new calibration solutions	C
	ORP fails Zobell check	Take into account temperature dependence of Zobell solution readings	5.3
	Internal failure	Return sonde for service	8

Depth unstable or inaccurate	Depth sensor has not been zeroed	Follow depth zero procedure	2.6.1
	Depth sensor access hole is obstructed	Follow depth cleaning procedure	2.10.2
	Depth sensor has been damaged	Return sonde for service	8
	Internal failure	Return sonde for service	8
Conductivity unstable or inaccurate. Error messages appear during calibration.	Conductivity improperly calibrated.	Follow cal procedure	2.6.1
	Conductivity probe requires cleaning	Follow cleaning procedure	2.10.2
	Conductivity probe damaged	Replace probe	8/C
	Calibration solution out of spec or contaminated	Use new calibration solution	C
	Internal failure	Return sonde for service	8
	Calibration solution or sample does not cover entire sensor.	Immerse sensor fully.	2.6.1
Installed probe has no reading	The sensor has been disabled	Enable sensor	2.9.5
	Water in probe connector	Dry connector; reinstall probe	2.10.1
	Probe has been damaged	Replace the 6560 probe	8/C
	Report output improperly set up	Set up report output	2.9.4
	Internal failure	Return sonde for service.	8
Temperature, unstable or inaccurate	Water in connector	Dry connector; reinstall probe	2.10.2
	Probe has been damaged	Replace the 6560 probe	8/C
Turbidity probe unstable or inaccurate. Error messages appear during calibration	Probe requires cleaning.	Follow probe cleaning procedure	2.10.2
	Probe requires calibration	Follow cal procedures	8.4
	Probe has been damaged	Replace probe	8
	Water in probe connector	Dry connector; reinstall probe	2.3.2
	Calibration solutions out of spec	Use new calibration solutions	C
	Wiper is not turning or is not synchronized.	Activate wiper. Assure rotation. Make sure set screw is tight.	2.10.2
	Wiper is fouled or damaged.	Clean or replace wiper.	2.10.2
	Internal failure.	Return probe for service.	8

SECTION 7 COMMUNICATION

This section describes the communication protocols that the Sondes use to communicate with the host system. **Section 7.1** gives a brief overview of the communication ability of the Sondes. The remaining sections describe available hardware and software features.

7.1 OVERVIEW

The sondes communicate via a serial port that can be configured as either a SDI-12, or a 3-wire RS-232 interface. The normal mode of operation for the sonde is RS-232, with the following configurations:

Baud rate: 300, 600, 1200, 2400, 4800, 9600
Data Bit: 8
Parity: None
Handshake: None

For further detail into the sondes RS-232 and SDI-12 implementations, see S**ections 7.3 and 7.4** respectively.

With these configurations, the Sonde is capable of interfacing to a variety of devices from a "dumb" terminal to numerous data collection platforms.

7.2 HARDWARE INTERFACE

Connection from the Sonde to the host computer is provided using the YSI 6095B MS-8 to DB-9 female adapter. This 6095B then connects to the standard DB-9 male connector on the host computer. The Sonde PC interface cable is wired for direct connection to a DTE device. The following table defines the interface circuits. The signals and their directions are defined with respect to use of the Sonde with the 6095B adapter.

Wire Color	Pin Description	DB-9	MS-4	MS-8
Yellow	RS232 TX	2	----	C
Orange	RS232 RX	3	----	D
Green	Alarm	----	----	E
Grey	RTS	----	----	G
Blue	CTS	----	----	H
Red	+ 12V DC	9	A	A
Black	GND	5	C	B
Purple	SDI-12	----	B	F
Bare	Shield	----	----	B

7.3 RS-232 INTERFACE

The sonde has an auto-baud feature that allows the instrument to automatically adjust to the terminal baud rate. If the sonde is set to a baud rate of 4800 and a 9600 baud terminal is attached to it, after a few carriage returns are entered, the sonde will recognize the communication mismatch and attempt to change its own internal baud rate to match the terminals.

7.4 SDI-12 INTERFACE

SDI-12 is an industry-standard serial digital interface bus. The bus was designed to allow compatibility between data collection devices and sensors of various manufacturers. The description below applies specifically to the Sonde implementation of SDI-12 interface. For complete SDI-12 technical specifications please contact:

Campbell Scientific, Inc.
P.O. Box 551
Logan, Utah 84321 USA
(801) 753-2342

SDI-12 is a single master multi-drop bus and command protocol. As many as 10 sensors can be connected to the bus at a time. Each sensor is pre-assigned a unique address from 0 to 9. Each Sonde is factory-set to address 0. The address can be changed in the System menu, **see Section 2.9.5, System menu** for details.

Running the sonde in SDI-12 mode requires it to be connected to a SDI-12 master device. An example of such a device is the YSI 6200 or units from Campbell Scientific or Handar Instruments. These instruments provide the commands necessary to communicate with the sonde in SDI-12 mode. In addition, the sonde also supports the following commands which are entered from the command line at the # prompt:

SDI12

This command activates SDI-12 mode. This is the only mode in which the Sonde will respond to any SDI-12 command. To exit to command line, press any key from the terminal connected to the RS-232 port.

The Sonde implements the basic SDI-12 command set. Below are the descriptions of each command and their responses.

The following notations are used:

a Sonde SDI-12 address (ASCII '0' to '9')

[CR] Carriage return (ASCII 13)

[LF] Line feed (ASCII 10)

Master Any SDI-12 compatible data collection device

```
Master:          aM!        Initiate a measurement.

Sonde:     atttn[CR][LF]
```

ttt - Maximum time in seconds the Sonde will take to complete the measurement.

n - Number of data that will be available when the measurement is completed. This number is the same as the number of output parameters set in the Report menu, as described in **Section 2.9.6, Report**. For ten or more parameters, the sonde returns ":", ";", "<", "=", ">", "?", "@", "A", "B",…etc.

After finishing the measurement, the Sonde will usually send a service request "a[CR][LF]" to the bus master. The bus master can then retrieve the measurement result by "D0" to "D9" commands (see below). If the Sonde does not send a service request within the specified maximum time, the measurement is canceled. The bus master can then restart with another "M" command.

```
Master:          aI!        Send identification.

Sonde:     allccccccccmmmmmmvvvxxx...xxx[CR][LF]
```

l - 2 character SDI-12 level number.

c - 8 character manufacturer identification. This field always contains "YSIIWQSG" (YSI Inc., Water Quality Systems Group).

m - 6 character model number. This field always contains "EM600_" or "EM 6920" (Environmental Monitoring System Sonde) depending on the sonde.

v - 3 character version number. This field holds the sonde's software version number ("100" for version 1.00).

```
Master:          aD0! to aD9!
Retrieve measurement/verifying data

Sonde:     a<values>[CR][LF]
```

<**values**>- 33 characters or less. This field holds one or more values resulting from a measurement or verifying sequence. A value contains between 1 to 7 digits with an optional radix mark (period '.' or comma ','). Each value must be preceded by its sign (either '+' or '-') since the sign is also used to delimit multiple values.

If the number of values returned by the "D0" command is less than the number specified in the previous response to "M" commands, the rest of the data can be retrieved by using "D1" to "D9" commands. The "D" commands are non-destructive. Thus if the same "D" command is issued

multiple times before the next "M" command, it will return the same data. If the response to the "D0" command is "a[CR][LF]" then either no "M" command was received before the first "D" command or the "M" command was canceled.

Example: Here is an example SDI-12 transaction. Here SDI-12 master will issue an Identify command followed by a Measure command. The sonde is configured with a report output of Temperature, Specific conductance, DO %, DO mg/L, pH (ISE1), ORP (ISE2), and Depth, a DO warm up time of 60 seconds, and an SDI-12 address of 1.

Master: 1I!

Sonde: 110YSIIWQSGEM600_107[CR][LF]

The bus master asked for identification and the Sonde returned data showing the following.

SDI-12 level:	1.0
Manufacturer:	YSIIWQSG
Model:	EMS600_
Version:	1.07

Master: 1M!

Sonde: 10617[CR][LF]

The bus master sent a measurement command. The Sonde will take a maximum of 61 seconds to finish the measurement. Upon completion, it will have 7 sensor data available.

Sonde: 1[CR][LF]

Master: 1D0!

Sonde: 1+17.5+12.05+98.7+8.25+6.45[CR][LF]

Master: 1D1!

Sonde: 1-325+10[CR][LF]

After finishing the measurement, the Sonde sent a service request to indicate completion. The bus master then sent the "D0" command to retrieve the data. There were 5 data returned. Since 7 readings should be available, the master continued with "D1" command and received the remaining data. The responses from "D0" and "D1" commands are:

Temperature:	17.5
Specific conductance:	12.05
DO %:	98.7
DO mg/L:	8.25
pH (ISE1):	6.45
ORP (ISE2):	-325
Depth:	10

SECTION 8 WARRANTY AND SERVICE INFORMATION

The sondes are warranted for two years against defects in workmanship and materials when used for its intended purposes and maintained according to instructions. All cables are warranted for one year. The depth, dissolved oxygen, temperature/conductivity, pH, chloride, turbidity, chlorophyll and pH/ORP combination probes are warranted for one year. Ammonium and Nitrate probes are warranted for six months. Damage due to accidents, misuse, tampering, or failure to perform prescribed maintenance is not covered. The warranty period for chemicals and reagents is determined by the expiration date printed on their labels. Within the warranty period, YSI will repair or replace, at its sole discretion, free of charge, any product that YSI determines to be covered by this warranty.

To exercise this warranty, write or call your local YSI representative, or contact YSI Customer Service in Yellow Springs, Ohio. Send the product and proof of purchase, transportation prepaid, to the Authorized Service Center selected by YSI. Repair or replacement will be made and the product returned transportation prepaid. Repaired or replaced products are warranted for the balance of the original warranty period, or at least 90 days from date of repair or replacement.

LIMITATION OF WARRANTY

This Warranty does not apply to any YSI product damage or failure caused by (i) failure to install, operate or use the product in accordance with YSI's written instructions, (ii) abuse or misuse of the product, (iii) failure to maintain the product in accordance with YSI's written instructions or standard industry procedure, (iv) any improper repairs to the product, (v) use by you of defective or improper components or parts in servicing or repairing the product, or (vi) modification of the product in any way not expressly authorized by YSI.

THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. YSI's LIABILITY UNDER THIS WARRANTY IS LIMITED TO REPAIR OR REPLACEMENT OF THE PRODUCT, AND THIS SHALL BE YOUR SOLE AND EXCLUSIVE REMEDY FOR ANY DEFECTIVE PRODUCT COVERED BY THIS WARRANTY. IN NO EVENT SHALL YSI BE LIABLE FOR ANY SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES RESULTING FROM ANY DEFECTIVE PRODUCT COVERED BY THIS WARRANTY.

AUTHORIZED U.S. SERVICE CENTERS

NORTH REGION

YSI Incorporated • Repair Center • 1725 Brannum Lane • Yellow Springs, Ohio • 45387 • Phone: (937) 767-7241• (800) 897-4151• Fax: (937) 767-9353 • E-Mail: ysi@info.com

SOUTH REGION

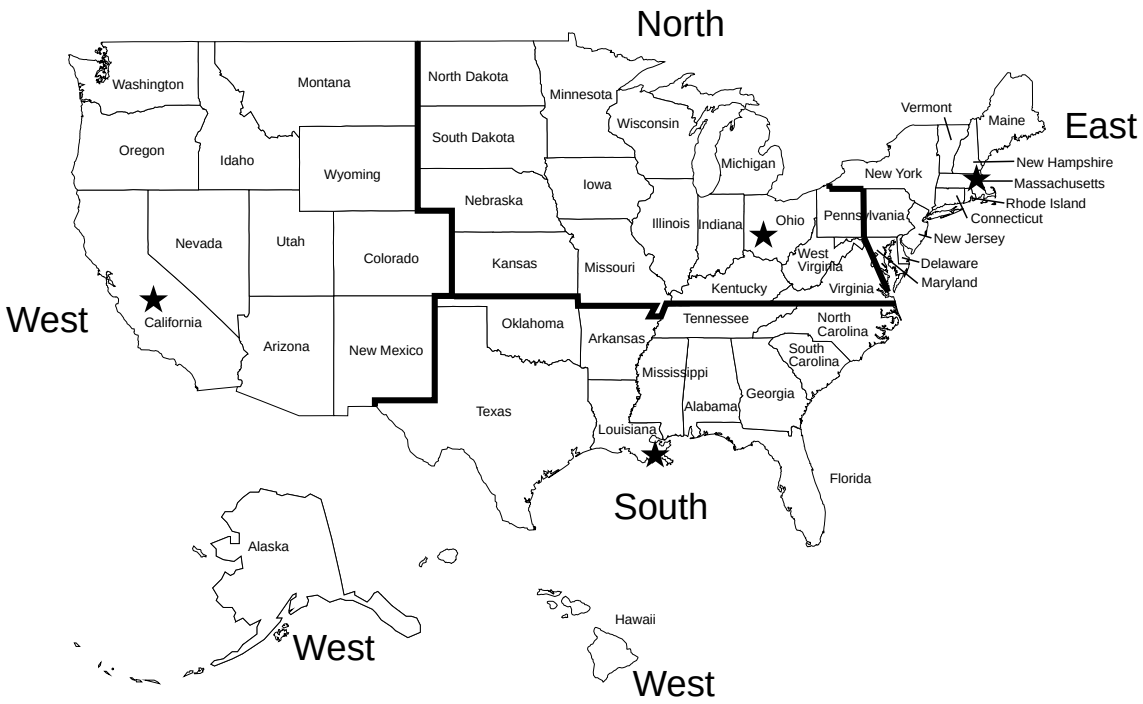
C.C. Lynch & Associates • 212 E. 2nd Street • Suite 203 • Pass Christian, Mississippi • 39571 • Phone: (800) 333-2252 • (228) 452-4612 • Fax: (228) 452-2563

EAST REGION

YSI Massachusetts, Inc. • 13 Atlantis Drive • Marion, MA • 02738 •Phone: (508)748-0366 • Fax (508)748-2543

WEST REGION

EnviroServices & Repair • 1110 Burnett Avenue, Suite D • Concord, CA • 94520 • Phone: (800)550-5875 • Fax: (510)674-8655



INTERNATIONAL SERVICE CENTERS

YSI Incorporated
YSI Incorporated • Repair Center • 1725 Brannum Lane • Yellow Springs, Ohio • 45387 • Phone: (937) 767-7241• E-Mail: info@ysi.com

Hydrodata Services Ltd.
Alexander Road • London, Colney • AL2 1JB • Phone: 011-44-2737-827-837 • Fax: 011-4401727-827-838

YSI Japan Ltd.
Sakura – Building 6-5-6-13 • Shinjuku, Shinjuku-ku, Tokyo • 160 • Phone: (81-3) 5360-3561 • Fax: (81-3) 5360-3565

CLEANING INSTRUCTIONS

NOTE: Before they can be serviced, equipment exposed to biological, radioactive, or toxic materials must be cleaned and disinfected. Biological contamination is presumed for any instrument, probe, or other device that has been used with body fluids or tissues, or with wastewater. Radioactive contamination is presumed for any instrument, probe or other device that has been used near any radioactive source.

If an instrument, probe, or other part is returned or presented for service without a Cleaning Certificate, and if in our opinion it represents a potential biological or radioactive hazard, our service personnel reserve the right to withhold service until appropriate cleaning, decontamination, and certification has been completed. We will contact the sender for instructions as to the disposition of the equipment. Disposition costs will be the responsibility of the sender.

When service is required, either at the user's facility or at YSI, the following steps must be taken to insure the safety of our service personnel.

- In a manner appropriate to each device, decontaminate all exposed surfaces, including any containers. 70% isopropyl alcohol or a solution of 1/4 cup bleach to 1-gallon tap water are suitable for most disinfecting. Instruments used with wastewater may be disinfected with .5% Lysol if this is more convenient to the user.

- The user shall take normal precautions to prevent radioactive contamination and must use appropriate decontamination procedures should exposure occur.

- If exposure has occurred, the customer must certify that decontamination has been accomplished and that no radioactivity is detectable by survey equipment.

- Any product being returned to the YSI Repair Center, should be packed securely to prevent damage.

- Cleaning must be completed and certified on any product before returning it to YSI.

PACKING INSTRUCTIONS

- Clean and decontaminate items to insure the safety of the handler.
- Complete and include the Cleaning Certificate.
- Place the product in a plastic bag to keep out dirt and packing material.
- Use a large carton, preferably the original, and surround the product completely with packing material.
- Insure for the replacement value of the product.

Cleaning Certificate

Organization _____

Department _____

Address _____

City _____ State __ Zip _____

Country _____ Phone _____

Model No. of Device __ Lot Number _____

Contaminant (if known) _____

Cleaning Agent(s) used _____

Radioactive Decontamination Certified?

(Answer only if there has been radioactive exposure) ___

Yes ___ No

Cleaning Certified By _____

Name Date

APPENDIX A HEALTH AND SAFETY

YSI Conductivity solutions: 3161, 3163, 3165, 3167, 3168, 3169

INGREDIENTS:

- ❑ Iodine
- ❑ Potassium Chloride
- ❑ Water

WARNING: INHALATION MAY BE FATAL.

***CAUTION*: AVOID INHALATION, SKIN CONTACT, EYE CONTACT OR INGESTION. MAY EVOLVE TOXIC FUMES IN FIRE.**

Harmful if ingested or inhaled. Skin or eye contact may cause irritation. Has a corrosive effect on the gastro-intestinal tract, causing abdominal pain, vomiting, and diarrhea. Hyper-sensitivity may cause conjunctivitis, bronchitis, skin rashes etc. Evidence of reproductive effects.

FIRST AID:

INHALATION: Remove victim from exposure area. Keep victim warm and at rest. In severe cases seek medical attention.

SKIN CONTACT: Remove contaminated clothing immediately. Wash affected area thoroughly with large amounts of water. In severe cases seek medical attention.

EYE CONTACT: Wash eyes immediately with large amounts of water, (approx. 10 minutes). Seek medical attention immediately.

INGESTION: Wash out mouth thoroughly with large amounts of water and give plenty of water to drink. Seek medical attention immediately.

YSI pH 4.00, 7.00, and 10.00 Buffer Solutions: 3821, 3822, 3823

pH 4 INGREDIENTS:
- ❑ Potassium Hydrogen Phthalate
- ❑ Formaldehyde
- ❑ Water

pH 7 INGREDIENTS:
- ❑ Sodium Phosphate, Dibasic
- ❑ Potassium Phosphate, Monobasic
- ❑ Water

pH 10 INGREDIENTS:
- ❑ Potassium Borate, Tetra
- ❑ Potassium Carbonate
- ❑ Potassium Hydroxide
- ❑ Sodium (di) Ethylenediamine Tetraacetate
- ❑ Water

CAUTION **- AVOID INHALATION, SKIN CONTACT, EYE CONTACT OR INGESTION. MAY AFFECT MUCOUS MEMBRANES.**

Inhalation may cause severe irritation and be harmful. Skin contact may cause irritation; prolonged or repeated exposure may cause Dermatitis. Eye contact may cause irritation or conjunctivitis. Ingestion may cause nausea, vomiting and diarrhea.

FIRST AID:

INHALATION - Remove victim from exposure area to fresh air immediately. If breathing has stopped, give artificial respiration. Keep victim warm and at rest. Seek medical attention immediately.

SKIN CONTACT - Remove contaminated clothing immediately. Wash affected area with soap or mild detergent and large amounts of water (approx. 15-20 minutes). Seek medical attention immediately.

EYE CONTACT - Wash eyes immediately with large amounts of water (approx. 15-20 minutes), occasionally lifting upper and lower lids. Seek medical attention immediately.

INGESTION - If victim is conscious, immediately give 2 to 4 glasses of water and induce vomiting by touching finger to back of throat. Seek medical attention immediately.

YSI Zobell Solution: 3682

INGREDIENTS:
- Potassium Chloride
- Potassium Ferrocyanide Trihydrate
- Potassium Ferricyanide

CAUTION **- AVOID INHALATION, SKIN CONTACT, EYE CONTACT OR INGESTION. MAY AFFECT MUCOUS MEMBRANES.**

May be harmful by inhalation, ingestion, or skin absorption. Causes eye and skin irritation. Material is irritating to mucous membranes and upper respiratory tract. The chemical, physical, and toxicological properties have not been thoroughly investigated.

Ingestion of large quantities can cause weakness, gastrointestinal irritation and circulatory disturbances.

FIRST AID:

INHALATION - Remove victim from exposure area to fresh air immediately. If breathing has stopped, give artificial respiration. Keep victim warm and at rest. Seek medical attention immediately.

SKIN CONTACT - Remove contaminated clothing immediately. Wash affected area with soap or mild detergent and large amounts of water (approx. 15-20 minutes). Seek medical attention immediately.

EYE CONTACT - Wash eyes immediately with large amounts of water (approx. 15-20 minutes), occasionally lifting upper and lower lids. Seek medical attention immediately.

INGESTION - If victim is conscious, immediately give 2 to 4 glasses of water and induce vomiting by touching finger to back of throat. Seek medical attention immediately.

YSI Ammonium Standard Solutions: 3841, 3842, and 3843

INGREDIENTS:
- ❑ Ammonium Chloride
- ❑ Lithium Acetate Dihydrate
- ❑ Sodium Azide (trace)
- ❑ Hydrochloric acid

CAUTION **- AVOID INHALATION, SKIN CONTACT, EYE CONTACT OR INGESTION. MAY AFFECT MUCOUS MEMBRANES.**

May be harmful by ingestion or skin absorption. May cause eye and skin irritation. The chemical, physical, and toxicological properties have not been thoroughly investigated.

Ingestion of large quantities of lithium salts can affect the central nervous system producing symptoms ranging from dizziness to collapse. It may also cause kidney damage, nausea, and anorexia. Note that the ingestion of harmful quantitites form the solutions is considered unlikely given the low concentration of lithium and the volumes likely to be handled.

FIRST AID:

INHALATION - Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Call a physician.

SKIN CONTACT - Remove contaminated clothing immediately. Wash affected area with soap or mild detergent and large amounts of water (approx. 15-20 minutes).

EYE CONTACT - Wash eyes immediately with large amounts of water (approx. 15-20 minutes), occasionally lifting upper and lower lids. Seek medical attention immediately.

INGESTION - Immediately rinse out mouth with large quantities of water. If reagent was swallowed, give 2 glasses of water and seek medical attention immediately.

YSI Nitrate Standard Solutions: 3885, 3886, and 3887

INGREDIENTS

- Potassium Nitrate
- Magnesium Sulfate
- Gentamycin Sulfate (Trace)

***CAUTION* - AVOID INHALATION, SKIN CONTACT, EYE CONTACT OR INGESTION.**

May be harmful by ingestion or skin absorption. May cause eye and skin irritation. The chemical, physical, and toxicological properties have not been thoroughly investigated.

FIRST AID:

INHALATION - Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Call a physician.

SKIN CONTACT - Remove contaminated clothing immediately. Wash affected area with soap or mild detergent and large amounts of water (approx. 15-20 minutes).

EYE CONTACT - Wash eyes immediately with large amounts of water (approx. 15-20 minutes), occasionally lifting upper and lower lids. Seek medical attention immediately.

INGESTION - Immediately rinse out mouth with large quantities of water. If irritation occurs or reagent was swallowed, seek medical attention immediately.

YSI Turbidity Standards: 3845, 3846, 3487, 6072, and 6073

INGREDIENTS

- Styrene divinylbenzene copolymer spheres

The material is not volatile and has no known ill effects on skin, eyes, or on ingestion. Therefore, no special precautions are required when using the standards. General precautions should be adopted as required with all materials to minimize unnecessary contact. Note, however, that the chemical, physical, and toxicological properties have not been thoroughly investigated.

FIRST AID:

SKIN CONTACT - Remove contaminated clothing. Wash affected area with soap or mild detergent and water.

EYE CONTACT - Wash eyes immediately with large amounts of water (approx. 15-20 minutes), occasionally lifting upper and lower lids. If irritation occurs, seek medical attention immediately.

INGESTION - Rinse out mouth with large quantities of water. If irritation occurs or reagent was swallowed, seek medical attention as a precaution.

YSI Replacement Desiccant 065802

INGREDIENTS

- Calcium Sulfate and Calcium Chloride

CAUTION **- AVOID INHALATION, SKIN CONTACT, EYE CONTACT OR INGESTION. MAY AFFECT MUCOUS MEMBRANES.**

FIRST AID:

SKIN CONTACT - Flush with water.

EYE CONTACT - . Flush with water. If irritation continues, obtain medical attention.

INGESTION - If patient is conscious, induce vomiting. Obtain medical attention.

APPENDIX B REQUIRED NOTICE

The Federal Communications Commission defines this product as a computing device and requires the following notice.

This equipment generates and uses radio frequency energy and if not installed and used properly, may cause interference to radio and television reception. It has been type tested and found to comply with the limits for a Class A or Class B computing device in accordance with the specification in Subpart J of Part 15 of FCC Rules, which are designed to provide reasonable protection against such interference in a residential installation. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient the receiving antenna
- Relocate the computer with respect to the receiver
- Move the computer away from the receiver
- Plug the computer into a different outlet so that the computer and receiver are on different branch circuits.

If necessary, the user should consult the dealer or an experienced radio/television technician for additional suggestions. The user may find the following booklet, prepared by the Federal Communications Commission, helpful: "How to Identify and Resolve Radio-TV Interference Problems". This booklet is available from the U.S. Government Printing Office, Washington, D.C. 20402, Stock No.0004-000-00345-4.

APPENDIX C ACCESSORIES AND CALIBRATION STANDARDS

STANDARD EQUIPMENT WITH YSI SONDES

- ❑ 600R, 600XL, 600XLM, 6820, 6600 or 6920 Sonde with Calibration Cup
- ❑ EcoWatch for Windows Software
- ❑ Operations Manual
- ❑ Guard for Probe Compartment
- ❑ 6570 Maintenance Kit
- ❑ 6560 Conductivity/Temperature Probe (not supplied with the 600R)

PROBES FOR THE SONDES

(see Appendix K, Sonde Specifications for the probes that your sonde supports)

- ❑ 6560 Conductivity/Temperature Probe
- ❑ 6561 pH Probe
- ❑ 6562 Rapid Pulse DO Probe
- ❑ 6565 Combination pH/ORP Probe
- ❑ 6026 Turbidity Probe, wiped
- ❑ 6036 Turbidity Probe, unwiped
- ❑ 6025 Chlorophyll Probe, wiped
- ❑ 6882 Chloride Probe
- ❑ 6883 Ammonium Probe
- ❑ 6884 Nitrate Probe

OPTIONAL ACCESSORIES FOR THE SONDES

- ❑ 062781 PC6000 Software (Available at no cost)
- ❑ 6027 Turbidity Wiper Kit
- ❑ 6024 Chlorophyll Wiper Kit
- ❑ 6035 Probe Reconditioning Kit for 6562 Dissolved Oxygen Probe
- ❑ 062655 Carrying case
- ❑ 6038 12 VDC Power Supply with 110 VAC input
- ❑ 6037 12 VDC Power Supply with 220 VAC input
- ❑ 6100 External Power Connector, attaches to 6095B Field Cable
- ❑ 6570 Maintenance Kit
- ❑ 068230 Short Probe Compartment Guard, for 6036 turbidity probe (non-wiping) for 6820 & 6920
- ❑ 5775 Membrane Kit
- ❑ 6108 Desiccant Cartridge Kit
- ❑ 6109 Desiccant Canister Kit
- ❑ 065802 Replacement Desiccant
- ❑ 6120 6-Series Operations Manual, Spanish
- ❑ 6121 6-Series Operations Manual, German
- ❑ 6089 Non-Vented CE Cable Kit

- ❑ 6194 Vented CE Cable Kit

CABLES FOR THE SONDES

- ❑ 6093 Field Cable, 100 ft (30 m)
- ❑ 6092 Field Cable, 50 ft (15 m)
- ❑ 6091 Field Cable, 25 ft (7.5 m)
- ❑ 6090 Field Cable, 8 ft (2.4 m)
- ❑ 6191 Field Cable, Vented, 25 ft (7.5 m)
- ❑ 6192 Field Cable, Vented, 50 ft (15 m)
- ❑ 6067B Low Cost Calibration Cable, Dry use only; 10 ft (3m)
- ❑ 6077B CE Calibration Cable, 10 ft. (3m)
- ❑ SP6093-L Special field cables available in 25 ft(7.6 m) increments; Maximum 1000 ft (305m)
- ❑ 6098B Field Cable to 610-D/610-DM adapter
- ❑ 6096 Field Cable to Flying Lead (wire) adapter, 15 ft (5m)
- ❑ 6095B Field Cable to Female DB-9 (PC Serial with Power Connector)
- ❑ 6099: 610 to Female DB-9 (PC Serial)
- ❑ 6100 External Power Connector, attaches to 6095B Field Cable (6ft)
- ❑ 6102: 610 to Portable Power Pack Adapter
- ❑ 6103 MS-8 Dust Cover (caps connector when not in use)

CONDUCTIVITY REAGENTS

- ❑ 3161 Calibrator Solution, 1,000 uS/cm (quart)
- ❑ 3163 Calibrator Solution, 10,000 uS/cm (quart)
- ❑ 3165 Calibrator Solution, 100,000 uS/cm (quart)
- ❑ 3167 Calibrator Solution, 1,000 uS/cm (box of 8 pints)
- ❑ 3168 Calibrator Solution, 10,000 uS/cm (box of 8 pints)
- ❑ 3169 Calibrator Solution, 100,000 uS/cm (box of 8 pints)

pH REAGENTS

- ❑ 3821 pH 4 Buffer (box of 6 pints)
- ❑ 3822 pH 7 Buffer (box of 6 pints)
- ❑ 3823 pH 10 Buffer (box of 6 pints)

ORP REAGENTS

- ❑ 3682 Zobell Solution (125 ml)

AMMONIUM REAGENTS

- ❑ 3841 1 mg/L ammonium-nitrogen standard solution
- ❑ 3842 10 mg/L ammonium-nitrogen standard solution
- ❑ 3843 100 mg/L ammonium-nitrogen standard solution

NITRATE REAGENTS

- ❑ 3885 1 mg/L nitrate-nitrogen standard solution
- ❑ 3886 10 mg/L nitrate-nitrogen standard solution
- ❑ 3887 100 mg/L nitrate-nitrogen standard solution

TURBIDITY REAGENTS

- ❑ 3845 0 NTU standard
- ❑ 6073 100 NTU standard suspension
- ❑ 3846 200 NTU standard suspension
- ❑ 3847 800 NTU standard suspension

DISPLAYS, LOGGERS, AND ACCESSORIES

- ❑ 610-D Display/Logger with Accessories
- ❑ 610-DM: 610-D with 128K of memory
- ❑ 610-DM: 610-D with 512K of memory
- ❑ 614 Ultraclamp, C-clamp Mount for 610
- ❑ 615 Leather Carrying Case for 610
- ❑ 616 Cigarette lighter adapter (powers and charges 610s)
- ❑ 617 Replacement Battery Pack for 610
- ❑ 6099: 610 to Female DB-9 (PC serial)
- ❑ 6097 Blank port plug for 610
- ❑ 6104 Replacement Charger Jack for 610
- ❑ 6042 Battery Charger for 610
- ❑ 6101 Portable Power Pack for 610 or sondes

LOGGER/TELEMETRY

- ❑ 1240: SDI-12 Logger for interfacing as many as 10 6-Series devices. Can also serve as RF telemetry platform (RF radio, battery, interface cable, junction box not included)
- ❑ 1240B1: 7 amp hour, lead acid 12 VDC rechargeable battery
- ❑ 1240B2: 20 amp hour, alkaline 6 VDC battery (2 required)
- ❑ 1240AC: 110 VAC charger/transformer assembly, charges 1240B1
- ❑ 1240SO: 1240 Solar Panel Assembly, includes panel, mount, cable
- ❑ 1240SE: 1240 Serial data interface cable, connects 1240 to PC
- ❑ 1240JU: 1240/6-Series Junction Box, provides input of multiple SDI-12 devices (standard configuration is for 5 devices)

Note: For RF radio frequency telemetry system applications, contact YSI Massachusetts Customer Support @ 1-800-363-3269 (USA) or 508-748-0366 or fax 508-748-2543.

SOFTWARE

- ❑ PC6000: MS-DOS compatible communication, upload, plotting
- ❑ 610SOFT: Software upgrade for YSI 610 D/DM
- ❑ 6920SOFT: Software upgrade for YSI 6-Series sondes

- ❑ EW-DOS EcoWatch for MS-DOS Applications
- ❑ EW-WIN EcoWatch for Windows (Use EW-WIN for 6-Series Applications)

APPENDIX D SOLUBILITY AND PRESSURE/ALTITUDE TABLES

Table 1: Solubility of Oxygen (mg/L) in Water Exposed to Water-Saturated Air at 760 mm Hg Pressure.

Salinity = Measure of quantity of dissolved salts in water.
Chlorinity = Measure of chloride content, by mass, of water.
$S(^0/_{00}) = 1.80655 \times \text{Chlorinity } (^0/_{00})$

Temp °C	Chlorinity 0 Salinity: 0	5.0 ppt 9.0 ppt	10.0 ppt 18.1 ppt	15.0 ppt 27.1 ppt	20.0 ppt 36.1 ppt	25.0 ppt 45.2 ppt
0.0	14.62	13.73	12.89	12.10	11.36	10.66
1.0	14.22	13.36	12.55	11.78	11.07	10.39
2.0	13.83	13.00	12.22	11.48	10.79	10.14
3.0	13.46	12.66	11.91	11.20	10.53	9.90
4.0	13.11	12.34	11.61	10.92	10.27	9.66
5.0	12.77	12.02	11.32	10.66	10.03	9.44
6.0	12.45	11.73	11.05	10.40	9.80	9.23
7.0	12.14	11.44	10.78	10.16	9.58	9.02
8.0	11.84	11.17	10.53	9.93	9.36	8.83
9.0	11.56	10.91	10.29	9.71	9.16	8.64
10.0	11.29	10.66	10.06	9.49	8.96	8.45
11.0	11.03	10.42	9.84	9.29	8.77	8.28
12.0	10.78	10.18	9.62	9.09	8.59	8.11
13.0	10.54	9.96	9.42	8.90	8.41	7.95
14.0	10.31	9.75	9.22	8.72	8.24	7.79
15.0	10.08	9.54	9.03	8.54	8.08	7.64
16.0	9.87	9.34	8.84	8.37	7.92	7.50
17.0	9.67	9.15	8.67	8.21	7.77	7.36
18.0	9.47	8.97	8.50	8.05	7.62	7.22
▼						▼

▼						▼
19.0	9.28	8.79	8.33	7.90	7.48	7.09
20.0	9.09	8.62	8.17	7.75	7.35	6.96
21.0	8.92	8.46	8.02	7.61	7.21	6.84
22.0	8.74	8.30	7.87	7.47	7.09	6.72
23.0	8.58	8.14	7.73	7.34	6.96	6.61
24.0	8.42	7.99	7.59	7.21	6.84	6.50
25.0	8.26	7.85	7.46	7.08	6.72	6.39
26.0	8.11	7.71	7.33	6.96	6.62	6.28
27.0	7.97	7.58	7.20	6.85	6.51	6.18
28.0	7.83	7.44	7.08	6.73	6.40	6.09
29.0	7.69	7.32	6.96	6.62	6.30	5.99
30.0	7.56	7.19	6.85	6.51	6.20	5.90
31.0	7.43	7.07	6.73	6.41	6.10	5.81
32.0	7.31	6.96	6.62	6.31	6.01	5.72
33.0	7.18	6.84	6.52	6.21	5.91	5.63
34.0	7.07	6.73	6.42	6.11	5.82	5.55
35.0	6.95	6.62	6.31	6.02	5.73	5.46
36.0	6.84	3.52	6.22	5.93	5.65	5.38
37.0	6.73	6.42	6.12	5.84	5.56	5.31
38.0	6.62	6.32	6.03	5.75	5.48	5.23
39.0	6.52	6.22	5.98	5.66	5.40	5.15
40.0	6.41	6.12	5.84	5.58	5.32	5.08
41.0	6.31	6.03	5.75	5.49	5.24	5.01
42.0	6.21	5.93	5.67	5.41	5.17	4.93
43.0	6.12	5.84	5.58	5.33	5.09	4.86
44.0	6.02	5.75	5.50	5.25	5.02	4.79
45.0	5.93	5.67	5.41	5.17	4.94	4.72

Table 2: Calibration Values for Various Atmospheric Pressures and Altitudes

PRESSURE			ALTITUDE		CALIBRATION VALUE
Inches Hg	**mm Hg**	**Millibars**	**Feet**	**Meters**	**Percent Saturation**
30.23	768	1023	-276	-84	101
29.92	760	1013	0	0	100
29.61	752	1003	278	85	99
29.33	745	993	558	170	98
29.02	737	983	841	256	97
28.74	730	973	1126	343	96
28.43	722	963	1413	431	95
28.11	714	952	1703	519	94
27.83	707	942	1995	608	93
27.52	699	932	2290	698	92
27.24	692	922	2587	789	91
26.93	684	912	2887	880	90
26.61	676	902	3190	972	89
26.34	669	892	3496	1066	88
26.02	661	882	3804	1160	87
25.75	654	871	4115	1254	86
25.43	646	861	4430	1350	85
25.12	638	851	4747	1447	84
24.84	631	841	5067	1544	83
24.53	623	831	5391	1643	82
24.25	616	821	5717	1743	81
23.94	608	811	6047	1843	80
23.62	600	800	6381	1945	79
23.35	593	790	6717	2047	78
23.03	585	780	7058	2151	77
22.76	578	770	7401	2256	76
22.44	570	760	7749	2362	75
22.13	562	750	8100	2469	74
21.85	555	740	8455	2577	73
21.54	547	730	8815	2687	72
21.26	540	719	9178	2797	71
20.94	532	709	9545	2909	70
20.63	524	699	9917	3023	69
20.35	517	689	10293	3137	68
20.04	509	679	10673	3253	67
19.76	502	669	11058	3371	66

Table 3. Conversion Factors for Feet/Meters, Celsius/Fahrenheit, mg/L/ppm

TO CONVERT FROM	TO	EQUATION
Feet	Meters	Multiply by 0.305
Meters	Feet	Multiply by 3.28
Degrees Celsius	Degrees Fahrenheit	5/9×(°F-32)
Degrees Fahrenheit	Degrees Celsius	9/5×(°C)+32
Milligrams per liter (mg/L)	Parts per million (ppm)	Multiply by 1

Table 4. Conversion Factors for Common Units of Pressure

	kilo Pascals	**mm Hg**	**millibars**	**inches H_20**	**PSI**	**inches Hg**
1 atm	101.325	760.000	1013.25	406.795	14.6960	29.921
1 kiloPascal	1.00000	7.50062	10.0000	4.01475	0.145038	0.2953
1 mmHg	0.133322	1.00000	1.33322	0.535257	0.0193368	0.03937
1 millibar	0.100000	0.750062	1.00000	0.401475	0.0145038	0.02953
1 inch H_20	0.249081	1.86826	2.49081	1.00000	.0361	0.07355
1 PSI	6.89473	51.7148	68.9473	27.6807	1.00000	2.0360
1 inch Hg	3.38642	25.4002	33.8642	13.5956	0.49116	1.00000
1 hectoPascal	0.100000	0.75006	1.00000	0.401475	0.0145038	0.02953
1 cm H_20	0.09806	0.7355	9.8×10^{-7}	0.3937	0.014223	0.02896

APPENDIX E TURBIDITY MEASUREMENTS

This is a question and answer guide that will help you optimize performance and trouble-shoot problems. The turbidity system of the YSI 6820, 6600 and 6920 is characterized by a great deal of flexibility from the point of view of the user. Some examples are shown below.

- ❑ The probe can be purchased in two configurations, with or without a mechanical wiper. If the wiper is in place it can be activated manually or automatically via the sonde software.

- ❑ The data from the turbidity sensor can be processed via a sophisticated filtering algorithm that has variable parameters inputted by the user.

- ❑ The turbidity system can be used in spot sampling applications with a YSI 610-D or 610-DM display/logger or a portable computer.

- ❑ The turbidity system on all sondes can be used for long term deployment applications using cable attachment to a data collection platform.

- ❑ The turbidity system can be used for long-term deployment applications with the YSI 6920 and 6600 by logging readings directly to sonde memory since they contain 'on board' power.

- ❑ A number of calibration options are offered with the YSI turbidity system.

This section is designed to help the user attain the maximum possible benefit from the turbidity system by supplementing the discussion of turbidity which is provided in the other sections of this manual (Getting Started, Basic Operation, Principles of Operation, and Maintenance). The presentation is designed around a number of questions that may be asked by a typical user of the 6820, 6600 or 6920 with our 6036 and 6026 turbidity sensors. It does not deal with specific instructions for operation of the sondes at the level presented elsewhere in the manual.

Question 1: Do I need a sensor with mechanical cleaning?

It depends on your usage plans. For most **spot sampling** applications, our non-wiped 6036 sensor is adequate. With the 6036, you must be very careful to remove bubbles from the optical surface during calibration and general use, but this is usually done easily by agitating the sonde up and down, or in a circular motion while in the medium. If you plan on using the turbidity sensor at the end of a long cable (>50 feet), this agitation may be more difficult. You may want to consider the purchase of a 6026 sensor with a wiper that can be manually activated to clean the optical face of bubbles during **spot sampling**. The key advantages of the unwiped 6036 are its lower cost and smaller size. The bottom line is that you probably want an unwiped 6036 sensor for **spot sampling**, but there are a few reasons to consider the wiped 6026.

When conducting **unattended monitoring** studies, you should always use a mechanically cleaned 6026 sensor and the instrument's software to activate the wiper at about the same interval as the data is acquired. Even if fouling from chemical or biological sources is not a significant problem in your unattended application, bubbles may form on the optical surface during deployment that can result in the transmission of erroneous readings. Once bubbles have formed, they can remain in place for long periods of time, resulting in corrupted readings for the

majority of the study. There is no doubt with regard to your options for **unattended monitoring**: use a mechanically cleaned probe.

Question 2: Where should I get my turbidity standards?

We recommend that you obtain your standards from YSI. We sell 100 NTU standard that is has been prepared from the AMCO-AEPA polymer which is suggested for use as a secondary turbidity standard by *Standard Methods for the Examination of Water and Wastewater*. This YSI standard has been certified to be 100 NTU by comparison of its turbidity output with that of freshly prepared formazin, the latter being the most accepted primary standard for turbidity. The YSI polymer standard can be linearly diluted with turbidity free water to generate standards that are lower than 100 NTU and can also be used as calibrants. For example, diluting 50 mL of 100 NTU standard to a total volume of 500 mL will yield a 10 NTU standard.

You can also use formazin as your source for turbidity standards. The formazin can be generated by the procedure found in *Standard Methods for the Examination of Water and Wastewater*, or it can be purchased as a 4000 NTU suspension that can be linearly diluted to form lower NTU standards. The advantage of the use of formazin is its cost; the primary disadvantage is that it is a hazardous reagent for which care must be taken in handling and disposal. In addition, formazin settles out much more rapidly than the AMCO-AEPA polymer and is less stable to degradation in dilute form. If you use formazin, we recommend that you purchase the 4000 NTU concentrate and dilute it, rather than generating the reagent from the chemical reaction described in *Standard Methods for the Examination of Water and Wastewater*. Whatever your source of formazin, be very safety conscious if you use it and be sure to follow the manufacturer's instructions with regard to its handling and disposal.

It is important that you do **not** use standards that are based on suspended materials other than formazin or AMCO-AEPA polymer. These standards may not read correctly when measured with the near infrared light source (860 nm) of the YSI Turbidity probes. If you have any doubts about the composition of your standards, consult your supplier and be certain that they are based on either formazin or AMCO-AEPA materials.

Question 3: Do I have to buy turbidity-free water for the 0 NTU calibration?

For most applications, purified water of any kind (distilled, deionized or filtered) will be acceptable for the 0 NTU standard. This water can be obtained from a laboratory or can be purchased at a local supermarket. It is not recommend that you use tap water as the 0 NTU standard. For maximum accuracy at very low NTU values (below the specification of the instrument), you may want to purchase turbidity-free water from YSI or another vendor.

Question 4: Should I carry out a 1-point, 2-point, or 3-point turbidity calibration, and what values should I use?

Even though the default calibration value in your sonde is reasonably appropriate for the "average" 6036 or 6026 sensor, you need to carry out some multi-point calibration (2- or 3-point) prior to your first usage. This will make certain that your system meets the YSI accuracy specifications provided in the Sonde's Operations manual. For the accuracy required in most environmental applications, a 2-point calibration is sufficient, and it recommended that the two points be a 0 and 100 NTU. The YSI turbidity sensor shows a minor degree of underlinearity

below 10 NTU which can be minimized by a 3-point calibration at 0, 10, and 100 NTU, but the effect on accuracy of this additional calibration point may not be worth the inconvenience for the average user. For example, if only a 0 and 100 NTU 2-point calibration is carried out, a sample that is actually 6.0 NTU would read about 5.4 NTU on the average probe.

Once the initial multi-point calibration has been carried out, we recommend that the accuracy of the sensor at low NTU be checked (or reset) by performing a **1-point** calibration at 0 NTU before each usage.

Question 5: How often should I perform additional multi-point calibrations?

Your frequency of calibration will depend on the conditions under which your sonde is used and on the degree of accuracy required in your application. Periodic calibration also confirms that the sensor is performing properly with regard to its sensitivity and general function.

Our empirical testing has indicated that the optical systems of the 6026 and 6036 probes are very stable and are likely to require only infrequent calibration to remain within the accuracy specifications of the instrument (+/- 5 % of reading or 2 NTU). Therefore, unless your sensor suffers catastrophic failure (usually indicated by jumpy or unreasonable field readings), you may only have to perform a multi-point calibration on a monthly basis. However, you should initially confirm the stability of the sensor for your typical sampling or monitoring application by frequently checking the sensor reading in a standard other than 0 NTU prior to increasing the time between multi-point calibrations.

Question 6: What about data filter and spike rejection settings for processing turbidity data from the YSI turbidity system?

As described in **Section 4, Principles of Operation**, some processing of raw turbidity data is usually beneficial in terms of outputting values that reflect the “average” turbidity at the site. Filter options designed to optimize this data processing are located in the sonde menu structure under both the 3-Sensor and the 4-Data Filter selections in the 6-Advanced submenu.

For most applications involving both spot sampling and monitoring, it is recommended the following settings with regard to data processing:

- ❑ In 3-Sensor, activate the “Turb Spike Filter”
- ❑ In 4-Data Filter, “Enable” the filter.
- ❑ In 4-Data Filter, “Disable” the “Wait for Filter” selection.
- ❑ In 4-Data Filter for turbidity, set the Time Constant to 12
- ❑ In 4-Data Filter for turbidity, set the Threshold to 0.010

These settings will normally produce data that is reflective of the “average” turbidity without having any significant effect on the response times of the other sensors. Increasing the values of the time constant, threshold, or both can further smooth the turbidity values.

Question 7: How do I set up the 6820, 6600 or 6920 system for use with a data collection platform or for logging to sonde memory?

First, as outlined above, use only a mechanically cleaned 6026 sensor with the sonde in this application. Second, set the data filter and turbidity spike filter settings as recommended in the previous question/answer. Third, access 2-Setup in the Advanced submenu and make certain that the "Turb Wipes" entry is set to "1". Finally, in the same submenu, set the "Twipe Int" parameter (in minutes) to the same value as the sample interval for which data will be transmitted to the logging device. Thus, if Sample Interval is set to 900 seconds (15 minutes) in the Run menu (either Discrete or Unattended), set "Twipe Int" to "15". Under these conditions, the turbidity wiper will be activated in a single bi-directional cleaning motion every 15 minutes to clean bubbles and fouling from the optics of the probe and minimize the chance of corrupted readings due to these factors. Note, however, that for Unattended applications with the sonde where data is being logged to internal sonde memory and "Autosleep RS232" is activated, it is only necessary that the value of Twipe Int be less than that of the sample interval selected for the Unattended study. Thus, if Twipe Int is set to 1 minute and the Unattended sample interval is set to 15 minutes, the sensor will only be cleaned every 15 minutes. For this reason, if you use your sonde primarily for Unattended monitoring, it is recommended that you leave Twipe Int at the default setting of "1", even though this is different from your sample interval. As outlined in the manual, in sites where fouling is more prevalent, it may be necessary to set "Turb Wipes" to a higher value, but a setting of "1" will be adequate for most water.

After sonde software setup is complete as outlined above, attach the sonde to a computer, 610-D, or 610-DM and calibrate according to the instructions in the manual and in Question 4 above. Then connect the sonde to the data collection platform using the proper cable/adapter and begin sampling according to the instruction manual. Alternatively, deploy the sonde without cable connections after setting the sampling dates, times, intervals, etc., as described in the instruction manual.

Question 8: How do I manually activate the turbidity wiper on a 6026 when the sonde is sampling?

If you are using the sonde with a 610, press the "T" key to activate the wiper. If the sonde is connected to a computer (sequential lines of data are present on the screen), press the "3" key to activate the wiper.

Question 9: What precautions should I take when using the sonde turbidity system with a 610-D or a 610-DM display/logger?

If you are using the 610 with an unwiped 6036 probe, the only special precaution is to make sure there are no bubbles on the optics during calibration and field use. As noted above, this can usually be accomplished by agitating the sonde. Beware of readings which are visually unreasonable, e.g. relatively clear water reading 100 NTU, or unstable. These symptoms are almost always due to bubbles and additional agitation of the sonde will be necessary to remove them.

If you are using the 610 with a mechanically cleaned 6026 probe in sampling operations, the wiper can be manually activated (Press "T" on the 610 keyboard) and sonde agitation is not required. However, the use of the wiper results in a relatively large surge of current that will reduce the battery life of the 610 to a degree that depends on the number of wipes utilized.

Occasionally, the 610 batteries may be discharged to a level such that they will power all of the sensors in the sonde (including turbidity), but will not be powerful enough to activate the wiper. You will be aware that the wiper is not turning by the length of the cleaning cycle displayed on the logger display after the "T" key has been pressed. If the cleaning cycle is approximately 12 seconds, the wiper is turning on command, if the cleaning cycle is approximately 24 seconds, the wiper is not being activated. Note, however, the cleaning cycle will always last 24 seconds the first time the wiper is activated for a sonde after being connected to power. If the wiper fails to activate, but the other sensors are functioning, you can continue to take readings until the LOBAT indicator of the display is visible. However, you will be forced to remove bubbles from the optics by agitating the sonde instead of using the wiper. Naturally, you should recharge the 610 batteries as soon as possible if this symptom occurs.

Question 10: What are the things most likely to give me problems when measuring turbidity with the YSI 6820, 6600 or 6920?

The turbidity system has been designed to be easy to calibrate, easy to use in both sampling and deployment applications, and trouble-free in normal usage. However, during our testing of prototype and production systems and sensors, we have observed occasional problems in calibration and in field applications. These difficulties are likely to be experienced only infrequently by users. In fact, most of these problems are not due to any malfunction in the turbidity system itself, but instead occur because of contaminated calibration solutions or the presence of bubbles on the optics of the probe. However, we have gained experience in separating problems which can be easily solved by the user from those which involve sensor malfunction and must be dealt with by YSI Customer Service and Product Repair. This section is intended to pass this experience along to the user.

You might see calibration errors. This problem could be due to bubbles on the optical surface, contamination of your 0 NTU standard, or a higher calibration standard which has not been prepared properly or has been contaminated or diluted inadvertently. The problem could also be due to an internal malfunction of the probe optical system. To troubleshoot the problem, do **not** override the cal error, return to the Main menu and activate data acquisition in the Run mode. Remove the sonde guard and place your thumb or finger over the optics of the probe while observing the data display. The reading should be large (either positive or negative) if the probe is responding correctly from an optical standpoint. If no response is noted, the probe must be returned to YSI Customer Service for repair or replacement. CAUTION: DO NOT ATTEMPT TO DISASSEMBLE THE PROBE YOURSELF. If the probe is functioning properly, replace the probe guard and place the sonde back into 0 NTU water. Agitate the sonde rapidly to remove bubbles and enter the calibration routine of choice (1-, 2-, or 3-point) from the **Calibrate** menu. Observe the readings for the 0 NTU standard. If values higher than about 5 NTU are observed, it is possible that your 0 NTU standard has been contaminated from debris that was retained on the sonde and probes from the previous field usage. Discard the water, rinse the sonde, and replace in new 0 NTU standard. After agitation, check the reading to see if it has been reduced. If so, proceed with the second calibration point. If not, contact YSI Customer Service for further assistance. If a calibration error occurs on the second point, use a new source of standard and try again. If an error still occurs, contact YSI Customer Service for further assistance.

You might observe readings during sampling which appear unreasonable from visual inspection of the water. Bubbles on the optics of the sensor usually cause the problem. Further agitate the sonde remove the bubbles. If the readings are still unreasonable, remove the sonde

completely from the water and then replace in the water. If problems are still evident, remove the sonde guard and check general probe function by placing your finger or thumb over the optics as described above. If the probe does not respond, contact YSI Customer Service.

You might see readings during sampling that you think are too jumpy. If this occurs, the water may be non-homogeneous with regard to the size of the suspended particles. The jumpiness that you are observing is probably real. However, if you want to smooth it out, you can incrementally increase the Time Constant and Threshold settings in the Data Filter menu to obtain the noise level which you desire.

You might observe single point spikes in data from deployment applications. These high readings may be real turbidity events caused by large particles passing over the optical surface at the time of measurement. As long as the spiking occurs only occasionally, there is no reason to believe that the turbidity system is malfunctioning. Depending on the site, these spikes may be a normal occurrence.

You might see a lot of positive and/or negative spikes in data from deployment applications. This symptom usually results from improper activation or parking of the wiper assembly. If it occurs with a new wiper assembly, make certain that the wiper rotates and parks correctly (opposite the optical surface) in 0 NTU standard. If the wiper does not rotate at all be certain that the setscrew of the assembly is contacting the flat part of the shaft and that the screw is securely tightened using the small hex key which is supplied with the wiper assembly. If the wiper still will not rotate on manual activation, contact YSI Customer Service. If the problem occurs with a wiper assembly which has been in the field for some time and is discolored or abraded, install a 6027 replacement with a new pad, assure function and correct parking in 0 NTU standard, and redeploy. If a high frequency of spikes still occurs in the deployment data, contact YSI Customer Service for further assistance.

APPENDIX F FLOW

Flow is only available in the **Sensors** menu on sondes that have vented level. The **Flow Setup** menu only appears when **Flow** is enabled in the **Sensors** menu.

Note: In this manual we describe how to use YSI's sondes to calculate flow from vented level. While weirs, flumes and the Manning equation are described briefly here, this manual is not a complete treatment of the subject. We make no claims on the accuracy or appropriateness of any of these techniques for any particular application.

Flow is a calculated value. Whenever there is a one to one relationship between the level of water in an open channel and the flow of water through it, then flow can be calculated from a level measurement. Many devices are designed to be placed in an open channel to improve the determination of flow. For example, a weir is a dam of specific geometry that restricts the flow of water while giving a very repeatable and accurate relationship between level and flow. There are several varieties of weirs, each designed for a specific application. Similarly, a flume also restricts flow producing a repeatable and accurate flow/level curve by forcing the flow not over a dam, but through a narrower portion of the channel. The flow is gradually narrowed, passed through a throat in the flume, and then gradually expanded back to the original channel width. As with weirs, there are several varieties of flumes each designed for a specific application.

The weir or flume is referred to as the primary measuring device, and the level meter is referred to as the secondary measurement device. There are three common types of weirs and seven types of flumes. Most of these are available in a number of sizes. Flow/level curves for common types and sizes are already programmed in the sonde so that it is only necessary to describe the primary measuring device to get flow readings. If you have a primary measuring device that is not already programmed, you have the option of entering either an equation or a table that defines the flow/level curve for your device. The table can also be used to calculate the flow of water in stream for which the flow/level data is available.

The Manning Equation is also available to calculate flow in an open channel without any restriction built explicitly for measuring flow. In this case the channel itself is the primary measuring device.

SETTING UP YOUR SONDE

WEIR OR FLUME

Getting your sonde ready to calculate flow for a weir or a flume can be summarized in the following simple steps. Using EcoWatch or a 610 display/logger to communicate with the sonde:

1. Enable **Flow** in the **Sensors** menu.
2. Go to **Flow Setup** menu in **Advanced Sensor.**
3. Choose a method (flume or weir), then a type (V-notch, rectangular, Parshall, etc.).
4. Choose a size.
5. Verify proper setup, choosing preferred units.
6. Choose preferred units in **Report**.

The **Flow Setup** menu only appears when **Flow** is enabled in the **Sensors** menu. Once in the **Flow Setup** menu you must define your primary measuring device by **Method, Type**, and **Size**. Note that the menus change depending upon your selection.

For example, after choosing **Flume** for your method, only types of flume are shown. So it is important to choose first the method, then the type, and finally the size. The following chart lists the primary devices that are programmed in the sonde.

Method	**Type**	**Size**
Weir	V-Notch	22½°, 30°, 45°, 60°, 90°, 120°
	Rectangular w/ End Contractions	Any size
	Rectangular w/o End Contractions	Any size
	Cipolletti	Any size
Flume	Parshall	1”, 2”, 3”, 6”, 9” 12”, 18”, 2’, 3’, 4’, 5’, 6’, 8’, 10’, 12’
	Palmer-Bowlus	4”, 6”, 8”, 10”, 12”, 15”, 18”, 21”, 24”, 27”, 30”
	Leopold-Lagco	4”, 6”, 8”, 10”, 12”, 15”, 18”, 21”, 24”, 30”
	Trapezoidal	Large 60° V, X-large 60° V, 2” 45° WSC, 12” 45° SRCRC
	Hs	0.4ft, 0.6ft, 0.8ft, 1ft,
	H	0.5ft, 0.75ft, 1 ft, 1.5ft, 2ft, 2.5ft, 3 ft, 4.5 ft
	HL	4 ft

After selecting the method, type and size of primary device, YSI strongly recommends that you verify that the sonde is set up properly. Find a chart that lists head versus flow for your primary measuring device. From the **Flow Setup** menu choose **Test Flow**. Then choose the units and flow units that are on your chart. Enter a few values for **Test Head** and compare the resulting **Test Flow** values against those found in the chart. Note that there may be minor differences in the least significant digit between the published values and the values given by the sonde. The difference is generally much less than the overall tolerance of the weir or flume being used.

The final step is to return to the **Report** menu and choose the flow and volume units you wish to have in the report. Note that the units in the report menu are independent of the units in the **Flow Setup** menu.

MANNING EQUATION

Once in the **Flow Setup** menu, choose **Manning** for the Method and then choose which type of channel the measurement is to be done in: closed pipe, U- channel, rectangular, or trapezoidal. Then choose the units for the equation. It is very important that the units chosen match the coefficients for the equation. Finally choose **Setup Manning** and define the width of the channel, its roughness and slope. Roughness is given in many fluid hydraulics texts and other engineering references as the Manning coefficient, n. Empirical values for n are given in the same references for most commonly found materials used in open channel construction. Slope is the ratio of rise to run. For example, if a channel drops one foot every one hundred feet, the value of the slope would be 0.01.

After setting up the **Manning Equation**, we strongly recommend that you verify that the sonde is set up properly. From the **Flow Setup** menu choose **Test Flow**. Then choose the units and flow units that you prefer. Enter a few values for **Test Head** and judge whether the resulting **Test Flow** values are reasonable. You might even want to try doing the calculation yourself.

The final step is to return to the **Report** menu and choose the flow and volume units you wish to have in the report. Note that the units in the report menu are independent of the units in the **Flow Setup** menu.

EQUATION

Equation is used to calculate flow with primary measuring devices other than the ones already programmed in the sonde. (**Table** is also sometimes useful for this purpose.)

Once in the **Flow Setup** menu you must define the equation. First choose the units for the equation. It is very important that the units chosen match the coefficients for the equation. The equation is of the form:

$$Q = K_1 \bullet H^{P_1} + K_2 \bullet H^{P_2}$$

Enter values for **K_1, P_1, K_2,** and **P_2.** Note: if you do not need the second term in the equation, simply enter zero for **K_2**.

After setting up the **Equation**, we strongly recommend that you verify that the sonde is set up properly. From the **Flow Setup** menu choose **Test Flow**. Then choose the units and flow units that you prefer. Enter a few values for **Test Head** and compare the resulting **Test Flow** values against values that you have calculated.

The final step is to return to the **Report** menu and choose the flow and volume units you wish to have in the report. Note that the units in the report menu are independent of the units in the **Flow Setup** menu.

TABLE

Table is used to calculate flow with primary measuring devices other than the ones already programmed in the sonde (**Equation** is also sometimes useful for this purpose). **Table** can also be used to calculate flow in streams for which there is data relating flow to level.

Once in the **Flow Setup** menu you must define your **Table**. Do this by entering up to 50 pairs of **Head** and **Flow** data points. Choose **Setup Table**. Be sure to choose the units that match the data in your table. Then enter each pair of points one by one. It is not necessary to enter the points in order. The software will put them in order. There are items on the menu to edit the next point or the previous point, to enter a new point, to delete a point or to delete the entire table. Later, when the sonde is measuring level and calculating flow, it will linearly interpolate between points in the table.

After setting up the **Table**, we strongly recommend that you verify that the sonde is set up properly. From the **Flow Setup** menu choose **Test Flow**. Then choose the units and flow units used in the table. Enter a few values for **Test Head** and compare the resulting **Test Flow** values against values in the original table.

The final step is to return to the **Report** menu and choose the flow and volume units you wish to have in the report. Note that the units in the report menu are independent of the units in the **Flow Setup** menu.

DEPLOYING YOUR SONDE

WEIR

Deployment of the sonde in a weir is normally very simple. Generally the point of level measurement is recommended to be at a distance upstream of the weir equal to 3 to 4 times the maximum level expected; however, do not deploy the sonde without knowing the design measurement point for the weir you are using. If flow is overly turbulent and readings are jumpy, then it may be necessary to install a stilling well for the sonde. If other water quality measurements are of interest (DO, pH, etc,) then take care that the stilling well does not overly isolate the sonde from the water in the channel.

Deploy the sonde so that the pressure sensor on the side of the sonde is slightly below the lowest level expected. Be sure the sonde is installed so that it cannot move during measurement.

Normally, a staff gauge is installed with a weir. After the sonde is installed, calibrate depth to the value read off the staff gauge.

Be sure also to follow the instructions printed in Appendix G, **Using Vented Level**.

FLUME

Generally there is a staff gauge installed in a flume at the point where the level should be measured. Be certain that you know the location of the measurement for the flume you are using. Some flumes are built with a stilling well outside of the flume. Deploying the sonde in the stilling well will give accurate level readings, but readings of other parameters like DO and pH may not be equivalent to those in the main flow of the flume. Also be aware that many flumes are not much bigger than the sonde. Installing the sonde in the flume may change the way the flume behaves, thus causing errors in flow readings. An ideal deployment would include a flume with a recess for the sonde that locates the pressure sensor properly, allows the other sensors to measure the water flowing through the flume, and does not significantly alter the

geometry of the flume. In a flume this means deploying the sonde horizontally. If possible, deploy the sonde so that the pressure sensor on the side of the sonde is slightly below the lowest level expected. Also be aware that the pressure sensor in the sonde is along the side of the sonde and not at its very tip. If a sonde is deployed vertically in the flume, then it may not be able to make measurements when the water level is low. Be sure the sonde is installed so that it cannot move during measurement.

Normally, a staff gauge is installed with a flume. After the sonde is installed, calibrate depth to the value read off the staff gauge.

Be sure to follow the instructions printed in Appendix G, **Using Vented Level**.

USING THE MANNING EQUATION IN AN OPEN CHANNEL

The channel should be large enough that the sonde does not significantly alter the flow of water. Most deployments will require the sonde to be in the channel horizontally so that the pressure sensor remains submerged at all times. Be sure that the sonde cannot move during the measurement. After installation measure the depth of water in the channel with a ruler and use that measurement to calibrate depth on the sonde.

Be sure to follow the instructions printed in Appendix G, **Using Vented Level**.

APPENDIX G USING VENTED LEVEL

Sondes that are equipped with level sensors use vented cables. The vented level option eliminates errors due to changes in barometric pressure. This is accomplished by using a special sensor that has been vented to the outside atmosphere by way of a tube that runs up through the sonde and cable. The tube must remain open and vented to the outside atmosphere to function. All storage caps must be removed and no foreign matter can block the openings. Never expose the sonde or the cable to the atmosphere for more than a few minutes without an active desiccant system in place. This prevents moisture from entering the vent tube.

Special field cables are used for the vented level. These cables have a vent tube that runs up the middle of the cable. Your sonde has a stainless steel connector on the top of it. In the center of this connector is the vent hole. When the cable is removed from the sonde, seal the sonde with the pressure cap provided with the sonde, to keep it clean and dry. The field cable should also be stored in a sealed plastic bag with some desiccant to keep it dry.

At the instrument end of every vented cable is a barbed fitting. This is to provide an attachment for a desiccant system. One of the two desiccant systems should always be attached to the sonde while exposed to the atmosphere to prevent moisture buildup in the vent tube. When dry and active, the desiccant is a distinct blue color. When exhausted it turns to a rose red or pink color. The desiccant can be regenerated in an oven. See **Section 2.10, Care, Maintenance and Storage** for the proper procedure.

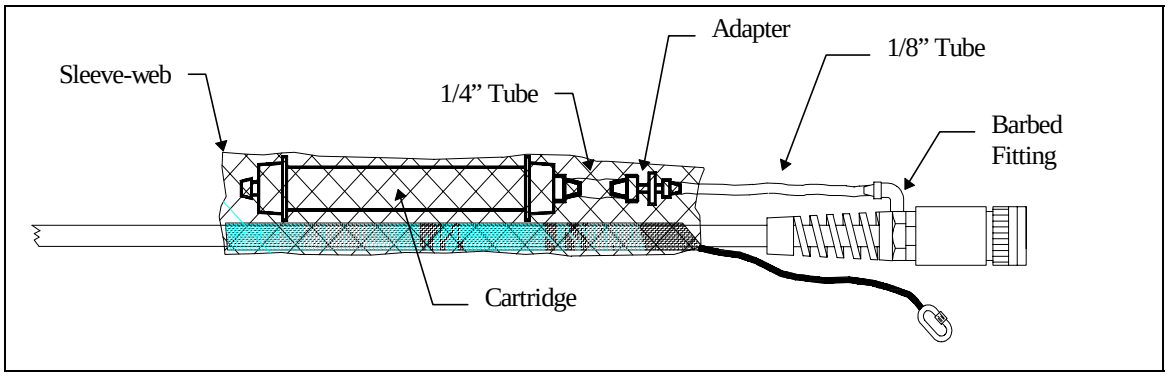
Avoid bending the cables sharply to prevent the vent tube from kinking.

Two desiccant systems are available, a cartridge kit and a canister kit. Either will keep moisture from entering the vent tube. The desiccant cartridge kit mounts right to the cable and is intended for short-term applications. The desiccant canister contains a larger amount of desiccant and is intended for long term deployment. The desiccant canister kit contains mounting brackets for mounting the canister to a nearby structure. The length of time that the desiccant remains active depends on several factors including heat and humidity.

When using vented level, you must enter altitude and latitude. From the sonde Main menu, select Advanced, then 3-Sensor. Enter the altitude in feet and the latitude in degrees of the measurement site. These values need to be accurate within 500 feet and 1 degree, respectively.

For best performance of depth measurements, users should ensure that the sonde's orientation remains constant while taking readings. This is especially important for vented level measurements and for sondes with side mounted pressure sensors.

INSTALLING THE CARTRIDGE KIT



1. Place the short length of 1/4" tubing onto the 1/4" side of the 1/8" to 1/4" adapter fitting. Seat firmly.

2. Place the length of 1/8" tubing onto the 1/8" side of the adapter fitting. Seat firmly.

3. Remove one of the plugs from the end of the desiccant cartridge and place the open end of the short length of 1/4" tubing onto the open end of the desiccant cartridge. Seat firmly.

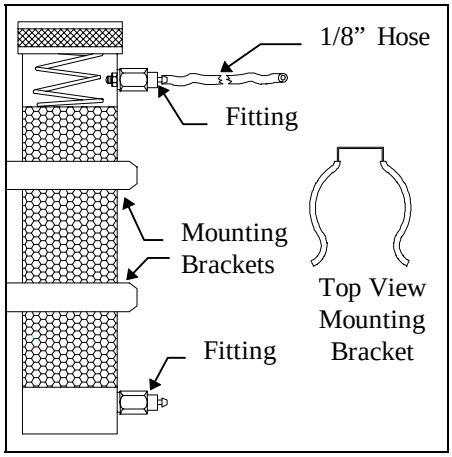
4. Remove the plug from the barbed fitting on the end of the cable and place the open end of the 1/8" tubing onto the cable fitting. Seat firmly.

5. Slide the sleeve-web over the end of the cable and the bail. Work the sleeve-web down the cable and over the cartridge taking care not to unplug the hose that connects the cartridge to the cable.

Optional: Using one of the tie-wraps, secure the hose to the cable taking care not to close off the hose.

The vent end of the cartridge should remain plugged until the sonde is ready for use. When putting the sonde into service, remove the plug to ensure that the sensor in the sonde is vented to the atmosphere.

INSTALLING THE CANISTER KIT



1. Remove the 1/8" NPT plugs from the stainless steel fittings on the canister.

2. Install the 1/8" NPT to 1/8" hose fittings into the stainless steel fittings located on the side of the desiccant canister. ***CAUTION***: Do not over-tighten!

3. Place the plugs over the fittings on the canister until you are ready to use the canister.

4. Using suitable screws fasten the canister mounting brackets to an appropriate support structure. The spacing between the brackets must accommodate the length of the canister. The canister must be located within a few feet of the cable end.

5. Remove the plug from the top fitting of the canister. Remove the plug from the barbed fitting on the end of the cable. Using the tubing provided in the kit, connect the canister to the fitting on the end of the cable. Remember to remove the remaining plug from the canister when ready to begin sampling. When putting the sonde into service, remove the plug to ensure that the sensor in the sonde is vented to the atmosphere.

APPENDIX H EMC PERFORMANCE

When using the YSI 6-Series sondes in a European Community (CE) country, please be aware that electromagnetic compatibility (EMC) performance issues may occur under certain conditions, such as when the sonde is exposed to certain radio frequency fields.

If you are concerned with these issues, consult the Declaration of Conformity that was enclosed with your instrument. Specific conditions where temporary sensor problems may occur are listed in this document.

If you are unable to locate the Declaration of Conformity that was shipped with your instrument, contact your local YSI representative, or YSI Customer Service in Yellow Springs, Ohio for a copy of the document. See **Section 8, Warranty and Service Information** for contact information.

APPENDIX I CHLOROPHYLL MEASUREMENTS

This is a question and answer guide that will help you optimize performance and trouble-shoot problems. While the YSI 6025 chlorophyll sensor provides a simple and convenient way to estimate phytoplankton concentration in the field, there are significant limitations associated with its use that the user should appreciate fully before beginning field studies. In addition, the chlorophyll systems of the YSI 6820, 6920, and 6600 are characterized by a great deal of flexibility from the point of view of the user. Some examples are shown below.

- ❑ The data from the chlorophyll sensor can be processed via a sophisticated filtering algorithm that has variable parameters that are input by the user.

- ❑ The chlorophyll system can be used in spot sampling applications with a YSI 610-D or 610-DM display/logger or a portable computer.

- ❑ The chlorophyll system can be used on all sondes for long term deployment applications using cable attachment to a data collection platform.

- ❑ The chlorophyll system can be used for long-term deployment applications with the YSI 6920 and 6600 by logging readings directly to sonde memory since they contain 'on board' power.

- ❑ A number of calibration options are offered with the YSI chlorophyll system.

This section is designed to help the user attain the maximum possible benefit from the YSI 6025 chlorophyll system by supplementing the discussions of chlorophyll provided in other sections of this manual. (**Section 2.1, Getting Started, Section 5, Principles of Operation, and Section 2.10, Care, Maintenance and Storage**). These are questions that may be asked by a typical user of the YSI 6820, 6600 or 6920 with the YSI 6025 chlorophyll sensors. It does not deal with specific instructions for operation of the sondes at the level presented elsewhere in the manual.

Question 1: What is the YSI 6025 chlorophyll probe designed to measure?

The YSI sensor is designed to estimate the phytoplankton content of environmental water. Phytoplankton concentrations can be useful in predicting detrimental algal blooms and, indirectly, in determining nutrient loading in environmental applications. The phytoplankton content is estimated by detecting the fluorescence from the chlorophyll in these species *in situ*, i.e., without disrupting the living cells. Note, however, that the sensor directly measures the fluorescence of all species in the water sample that occurs when they are irradiated with blue light (centered at about 470 nm). Usually most of the fluorescence is due to the chlorophyll in the phytoplankton, but it is important to remember that any compounds which are present in the water sample (either in chemical or biological form), and fluoresce under the optical constraints of the sensor, will contribute to the readings.

Question 2: What level of accuracy can be expected in my chlorophyll determinations with the YSI 6025?

YSI feels that the user will attain about the same accuracy with the YSI 6025 as with other commercial fluorometers that are designed to carry out *in situ* determinations of environmental chlorophyll. As for all measurements of this type, the accuracy will be less than that attained if the user collects water samples and analyzes them in the laboratory by disrupting cells and quantifying by spectrophotometric or HPLC of the extracted molecular chlorophyll as described in *Standard Methods*. The relative accuracy of the *in situ* measurement will be completely dependent on the method of calibration which the user employs (see next question). No matter what calibration technique is used, however, the readings from the YSI 6025 should approximately track the chlorophyll trends in the environmental water being analyzed. For example, if the user deploys the sensor and acquires readings over time at a standard sampling interval (e.g., every 15 minutes), the changes in the chlorophyll data will usually reflect increases or decreases in the phytoplankton content at the site over a long period of time. If the user makes horizontal or vertical profiling spot readings in the same body of water, then the sensor output will usually indicate the presence of more or less phytoplankton at the various sampling sites.

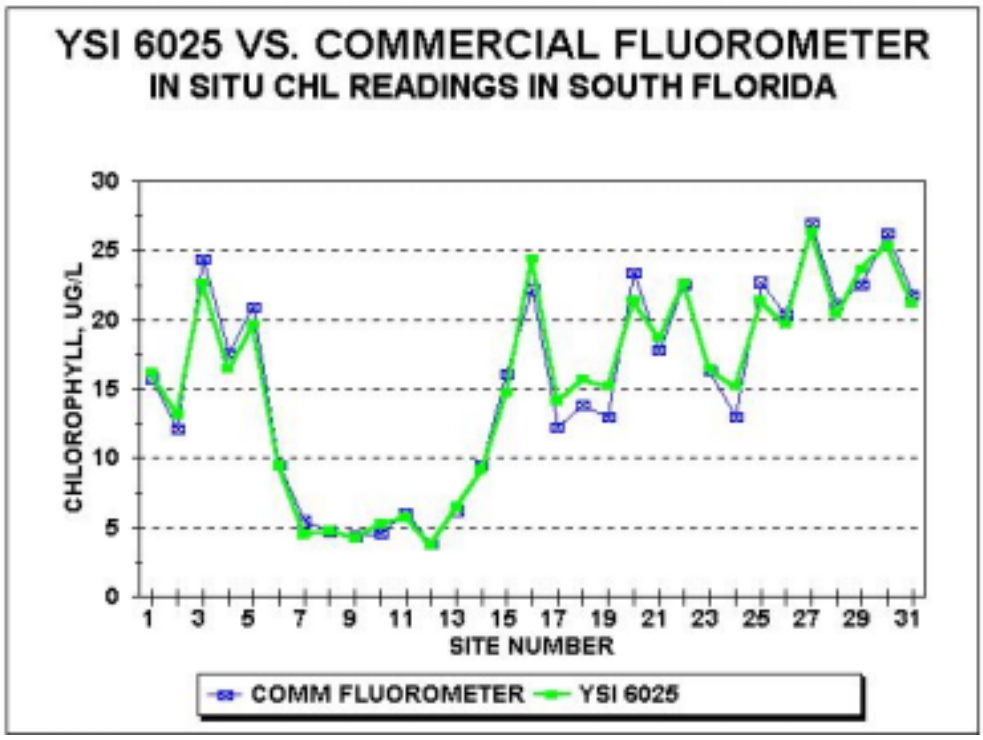
It is important for the user to remember that, because of the limitations defined in this appendix and in **Section 5, Principles of Operation**, YSI is unable to quote an accuracy specification for the *in situ* measurement of chlorophyll.

Question 3: What calibration methods are available for the YSI 6025?

There are two basic methods of calibration as described below. The first (and easier) involves setting the sensitivity of the sensor by the use of a chemical dye solution. The second (and more accurate) requires the user to collect water samples of the environmental water in question during sampling or monitoring studies, analyze the samples in the laboratory after cell disruption, and use the chlorophyll values determined by this method to adjust the data acquired with the YSI 6025.

<u>Dye Calibration:</u>

The sensitivity of each YSI 6025 chlorophyll sensor is set within a certain range at the factory using deionized water as the zero reading and the chemical dye acridine orange as a chlorophyll fluorescence simulator. The preparation and use of solutions of this dye use are described in the **Section 5, Principles of Operation**. Using this method, the sensor is set to emulate the average *in situ* chlorophyll values as determined by other commercial fluorometers. For example, the following plot shows a comparison of YSI 6025 chlorophyll values at several sampling sites in south Florida with those of an *in situ*, chlorophyll-only instrument from another established manufacturer.



Note the excellent tracking between the two sets of values using the default calibration of the sensor. However, each YSI 6025 sensor has a slightly different sensitivity, so users can increase the relative accuracy by preparing their own solutions of acridine orange and adjusting the sensitivity of the sensor. Be sure to take the proper precautions when using acridine orange as described in the **Section 5, Principles of Operation** and the dye supplier's instructions.

Note: It is important to realize that, even if the default sensitivity of the YSI 6025 is accepted by the user, the zero reading of the probe should be adjusted by a 1-point calibration procedure using DI water as the sample. Most YSI 6025 sensors will show slightly negative chlorophyll or fluorescence readings on receipt and this offset must be removed by the proper zero calibration protocol.

Calibration Using Phytoplankton Samples:

As outlined in **Section 5, Principles of Operation**, the calibration standard that provides the best measure of accuracy for *in situ* chlorophyll sensors is a portion of an phytoplankton suspension that has been analyzed for chlorophyll by the extractive procedure described in *Standard Methods*. If possible, we recommend the use of this procedure and further recommend that the phytoplankton suspension be taken from the site being monitored so that the species producing the fluorescence in the standard are as close as possible to the field organisms. Calibration by this method can be carried out either before or after making field measurements with the YSI 6025. In the "before" method, a water sample is collected at the site in question prior to a sampling or monitoring study. One portion of the sample is analyzed in the laboratory by either spectrophotometry or HPLC after cell disruption and then the YSI 6025 is placed in the remaining sample and the sensitivity set to the analyzed value. If this procedure is

employed, then the values taken after the calibration will be as accurate as possible with no further adjustment. In the "after" method, a water sample is taken during the sampling or monitoring study (where the YSI 6025 is used) and then brought to the laboratory for analysis after completion of the field measurements are complete. The field data must then be adjusted, either manually or in a spreadsheet, according to the laboratory value. For example, if the YSI 6025 value for a particular site is 5 ug/L chlorophyll and the laboratory value is 8 ug/L, then all of the values for the study should be multiplied by 1.6 (8/5) to be as accurate as possible.

Note: If using the "before" method, be sure to carry out a 2-point calibration protocol using deionized water as the zero standard and the known phytoplankton suspension value as the second point. If using the "after" method, carry out a 1-point calibration of the sensor before the study, using deionized water as the zero value as for the dye calibration procedure above.

Question 4: If the sensor is calibrated using the phytoplankton suspension method, will my field data be totally accurate?

No, they will only be more accurate than if the dye calibration method is used. The limitations for all *in situ* chlorophyll determinations described in **Section 5, Principles of Operation** will almost certainly compromise the accuracy of your data even if you employ the best calibration method possible. For example, different phytoplankton species are likely to fluoresce differently *in situ* even if the actual chlorophyll content is the same. Thus, unless the biological species are perfectly homogeneous with regard to site in a sampling study and with regard to time in a monitoring study, inaccuracy will occur if only a single phytoplankton calibration is performed. In addition, the fluorescence intensity of many phytoplankton shows a diurnal cycle even though the same amount of material is present. Under this limitation, the time of day at which calibration samples are taken would have to be identical to the time of field measurement for the chlorophyll values determined by the two methods to agree consistently. This level of synchronization is usually not practical.

The key point to remember is that *in situ* chlorophyll determinations made with any fluorometer are likely to be less accurate than those measured by laboratory analysis of individual samples. The advantage of the *in situ* method is its convenience and ability to readily track changes in relative phytoplankton values via indirect fluorescence readings.

Question 5: Will the chlorophyll values determined *in situ* with the YSI 6025 be reportable for compliance purposes?

Probably not. Because of the limitations on the method outlined above and in the **Section 5, Principles of Operation**, there is always inaccuracy in the *in situ* method. It might be possible to work with a particular regulatory agency to develop specific correlation protocols between *in situ* and laboratory-determined chlorophyll values for a particular site, but generation of this methodology is left to the user.

Question 6: I have seen molecular chlorophyll standards advertised. Can these be used to calibrate the YSI 6025 sensor?

Probably not. The standards are usually only soluble in organic solvents such as acetone that would cause serious damage to the materials used in the YSI 6025 probe. Even if molecular

chlorophyll standards that are soluble in aqueous media were available, their fluorescence is not likely to emulate *in situ* chlorophyll fluorescence any better than the dye standard described above.

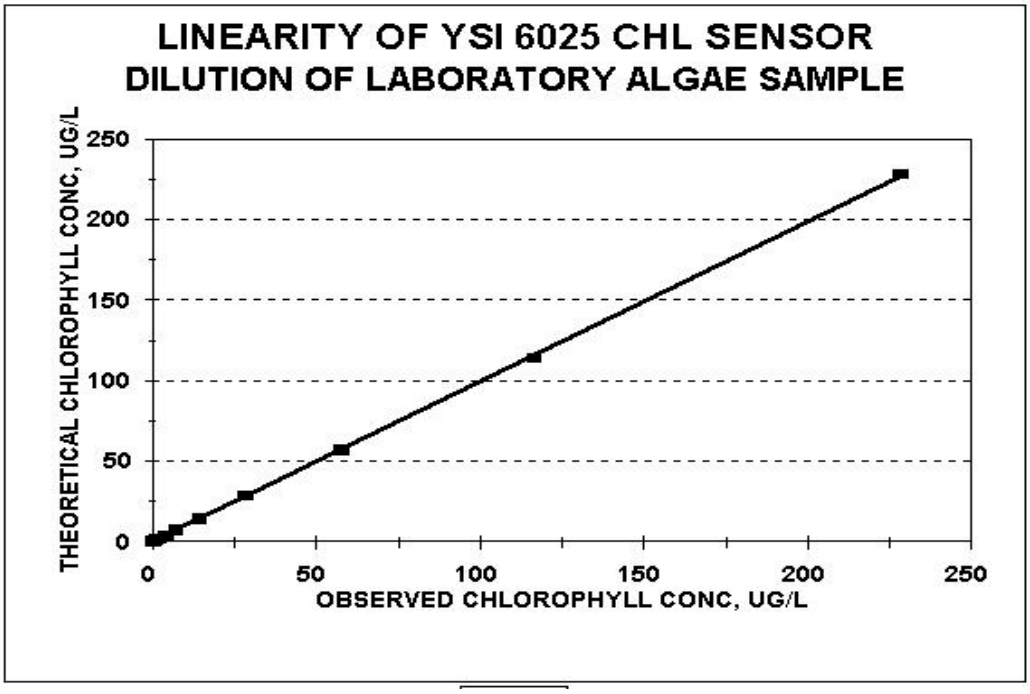
***Caution*:** Do not expose the YSI 6025 to calibrant solutions involving any solvent other than water or very dilute aqueous acid mixtures. Damage to the sensor under these conditions will not be covered under warranty.

Question 7: The *Standard Methods* procedure generates values designated as "chlorophyll a". Is this species the reporting unit for the YSI 6025?

No. The different types of chlorophyll cannot be differentiated by the YSI 6025, or by virtually any *in situ* fluorometer. The values from the YSI 6025 should be reported either as relative fluorescence units or in ug/L of general chlorophyll as long as the method of determination (and its limitations) is specified.

Question 8: Is the YSI 6025 sensor linear with regard to changes in phytoplankton content?

Yes. The sensor is very linear as evidenced by the following plot that shows the results of a serial dilution of a laboratory algae sample. This linearity on a particular algal species maximizes the ability of the sensor to track relative phytoplankton changes from site to site or during a monitoring study.



Question 9: What Data Filter settings should I use to obtain the best possible field chlorophyll readings?

As described in **Section 4, Principles of Operation**, some processing of raw chlorophyll data is usually beneficial in terms of outputting values that reflect the "average" chlorophyll at the site.

Filter options designed to optimize this data processing are located in the sonde menu structure under both the 3-Sensor and the 4-Data Filter selections in the Advanced submenu.

For most applications involving both spot sampling and monitoring, the following settings are recommended with regard to data processing:

- ❑ In 3-Sensor, Disable the "Chl Spike Filter"
- ❑ In 4-Data Filter, "Enable" the filter.
- ❑ In 4-Data Filter, "Disable" the "Wait for Filter" selection.
- ❑ In 4-Data Filter for chlorophyll, set the Time Constant to 12
- ❑ In 4-Data Filter for chlorophyll, set the Threshold to 1

These default settings will normally produce data that is reflective of the "average" chlorophyll without significantly slowing the response time of the sensor for either sampling or monitoring applications. Increasing the values of the time constant, threshold, or both can further smooth the chlorophyll values. In some cases, activation of the "Chl Spike Filter" in the Advanced|Sensor menu will produce more stable readings. Variation in the default settings should be based on empirical data taken at your particular site.

Question 10: I understand the use of the 1-point and 2-point calibration protocols as described above. Should the 3-point chlorophyll calibration procedure ever be used?

Given the overall limitations of the method and the demonstrated excellent linearity of the sensor, there is probably no reason for the average user to perform a 3-point calibration that involves the use of zero and two additional fluorescent standards. The feature is provided in the unlikely event that the fluorescence of a particular phytoplankton species is found to be slightly non-linear on serial dilution. The 2-point calibration method is normally recommended and will cover virtually all applications.

Question 11: How often should I calibrate my YSI 6025 sensor?

You should <u>always perform a zero point calibration</u> in deionized water before each use of the YSI 6025 sensor.

The frequency of multi-point calibration depends on the calibration method employed. Testing at YSI has indicated that the optical system of the YSI 6025 is very stable and is unlikely to show significant drift over time. Thus, if you are using the dye calibration method (with its limitations), you may only have to perform a 2-point calibration on a monthly basis for sampling studies or before each deployment study. In general, you should perform periodic 2-point calibrations using a dye sample more frequently during your initial studies with the YSI 6025 to empirically determine its drift and use these results to set up your calibration frequency.

If you are calibrating the sensor with phytoplankton suspensions to obtain better accuracy as described above, then clearly you will be performing a 2-point calibration for every sampling or monitoring study.

Question 12: Are there precautions that I should take when acquiring samples for laboratory analysis?

Yes. The key is to obtain a sample which is representative of the water being measured by the YSI 6025 *in situ*. The mistake most often made is to simply immerse an open bottle in the environmental water. Under these conditions, any macroscopic surface plant or algal matter (which also contains chlorophyll) will also be introduced into the sample even though it is not present in the subsurface zone where the probe is measuring fluorescence. If this happens, your laboratory analysis will always be erroneously high relative to the *in situ* chlorophyll data from the YSI 6025.

For surface sampling you can minimize this effect greatly by placing the sealed bottle a foot or more below the water surface and only then removing the cap and allowing the container to fill. The cap should then be reinstalled before removing the bottle from the water. A better technique is to acquire commercially available water sampling devices that are designed specifically to acquire a representative sample at a particular depth.

You should also take precautions to stabilize your samples for transport back to the laboratory. The samples should be kept cool and in the dark (e.g., in an ice chest) until the analytical procedure has begun. Some users prefer to filter the sample in the field and keep the filter pads on ice in the dark during transport.

Question 13: My environmental sites have a lot of visible floating algae, but my YSI 6025 chlorophyll sensor shows very low readings. What is causing this paradox?

The YSI 6025 is not designed to measure macroscopic algal or plant material that floats on the surface. Rather it measures the fluorescence from the microscopic phytoplankton that is suspended below the surface of the water. It is fairly common to see mats of floating algae on environmental water, which have low subsurface phytoplankton concentrations.

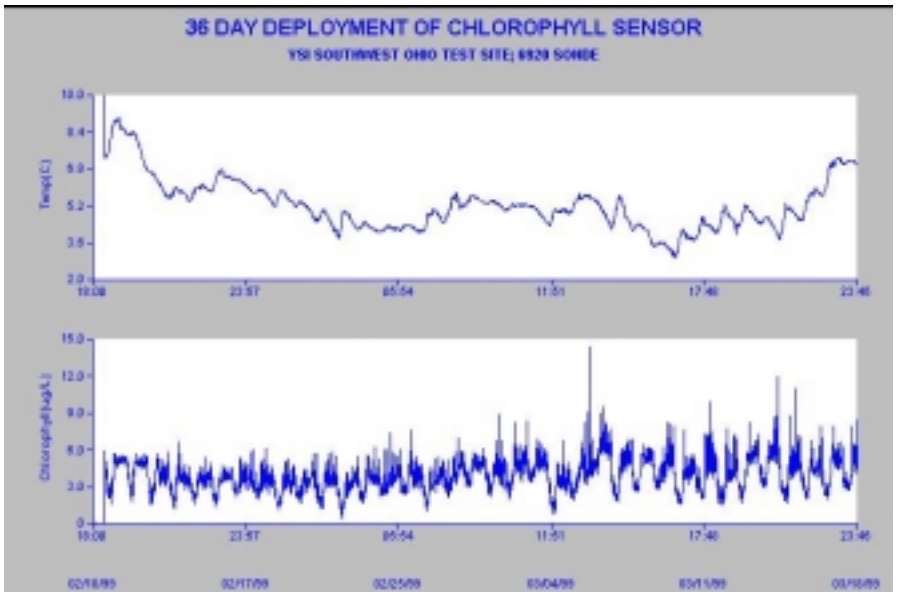
Question 14: What can I do to obtain the best possible data from my YSI 6025 sensor in sampling studies?

Two factors are most important. The first is to make certain that the readings are stable before manually recording them or logging them to a computer or YSI 610 display/logger. You should visually monitor the readings for at least 1-2 minutes to assure stability after the sonde is immersed. The second factor is that you should always manually activate the mechanical wiper on the sensor after sonde immersion but before beginning the visual monitoring of the readings. The cleaning cycle is necessary to remove bubbles from the optical face, which are certain to cause erroneous readings. If the observed readings appear unusual after the first cleaning cycle, activate the wiper repeatedly to assure that all bubbles are removed. Manual activation of the wiper mechanism is accomplished by pressing the “3” key on a laptop computer or the “t” key on a 610 display/logger.

You should also allow adequate time the sonde to acclimate to the temperature of the water at the site.

Question 15: What sort of "noise" level is expected for unattended monitoring studies?

All environmental water is somewhat heterogeneous with regard to phytoplankton content and this factor will cause some noise or jumpiness in long term monitoring studies for chlorophyll. The extent of the noise will be dependent on the your site. The data from a typical 36-day deployment at a YSI test site (lake in southwestern Ohio) is shown in the figure below as a reference.

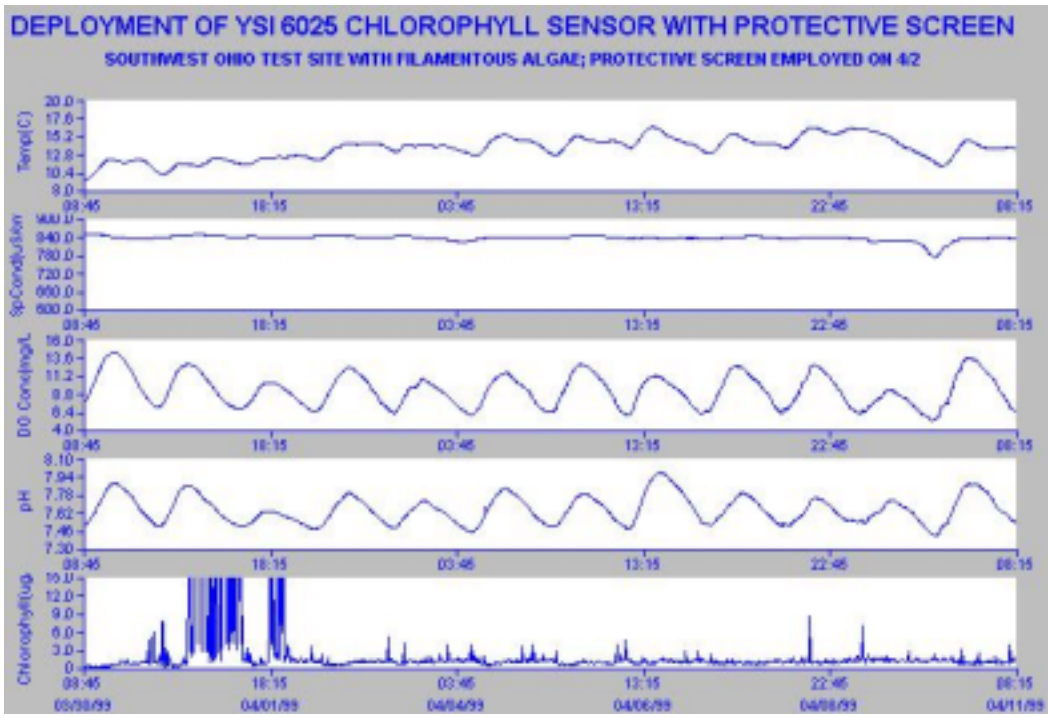


Note, however, that your may observe less or more noise at your site with no compromise in sensor performance. Occasional spikes during a monitoring study are normal and usually simply indicate the transient passage of a large phytoplankton particle over the optical face during the time of sampling.

If you consistently observe periods in your monitoring study where the data is clearly unreliable due to a large number of very high spikes, then you may have to take additional precautions to minimize the effect (see next question).

Question 16: My unattended monitoring data shows a large number of chlorophyll spikes that clearly do not reflect the average phytoplankton content of the water. What is causing this effect and is there anything I can do to minimize it?

Usually this effect, shown in the initial chlorophyll readings in the figure below, is caused by the presence of subsurface macroscopic filamentous algae.



The flexible algal strands can become attached to the wiper arm and sometimes are resident on the probe optics even after a cleaning cycle. The key to decreasing the spiking effect is to minimize the free algae, which is present in the probe compartment of the sonde. This can sometimes be accomplished by encasing the sonde guard in standard fiberglass window screen wire which is available at most hardware stores and then anchoring the screen with rubber bands as shown in the picture below.

Note the significant improvement in the overall noise level of the readings after the screen was installed on 4/2/99. However, there is no guarantee that this solution will completely solve

spiking problems caused by macro algal species. In some applications, it may be necessary to clean the sonde and probes at a frequent interval to minimize the number of erroneous readings.

Question 17: How often should I change my mechanical wiper?

For sampling and monitoring studies, YSI recommends periodic inspection of the wiper to assure that it is not fouled with silt or biological material and is not abraded. If any of these symptoms is noted, the wiper should be changed immediately. YSI also recommends that the wiper be changed as a precaution prior to each long term monitoring study. Spare wipers are available in the YSI 6024 Wiper Kit.

***Caution*:** When replacing the wiper, be sure that you do not rotate the wiper arm after it is tightened to the shaft. This may damage the internal motor/gearbox mechanism and could void your warranty.

Question 18: Do I have to worry about the effect of variable temperature on my field readings?

This factor is definitely a consideration depending on the level of reliability you require if the water at your site is at a significantly different temperature from that of calibration. YSI studies show that, while the optics and electronics of the sensor show very little temperature effect, the fluorescence of phytoplankton samples does vary significantly with temperature. Generally, the chlorophyll in biological samples shows increased fluorescence at lower temperatures with a factor of 1-2 % per degree Celsius. In practice, this means that if, for example, the calibration temperature is 25 C and the water temperature at the site is 10 C, the observed chlorophyll readings will be erroneously high by 15-30 %. The “Chl Tempco” factor in the Advanced|Sensor menu can be used to partially compensate for this error, if the user has some knowledge of the temperature effect on the particular phytoplankton at the site. The factor can be empirically determined by bringing a sample of the environmental water to the laboratory and determining its fluorescence at ambient temperature and low temperature. (Simply cool the sample in a refrigerator for the latter reading.) The calculated factor can then be entered into the sonde software. See the example in **Section 5, Principles of Operation**.

Question 19: The wiper on my YSI 6025 probe does not park directly opposite from the optical surface. What can I do to correct this symptom?

The wiper rotation and parking algorithm are calibrated during the Discrete Sample mode each time the sonde is powered down and then has power applied again. You can simulate the power down/power up routine by typing “reset” at the # prompt. After the resetting operation has been completed, type “menu” at the # prompt and then begin a Discrete Sample study from the Run menu. The wiper should park directly opposite the optical surface after the calibration procedure has been carried out. You should definitely calibrate the parking of your wiper every time you change probes and you will probably want to carry out the power down/power up protocol when you change wipers on the same probe.

Question 20: I suspect that my YSI 6025 chlorophyll sensor is not performing properly. What should I do before contacting YSI Customer Service to facilitate resolving the problem?

You should perform two diagnostic tests to help YSI personnel determine if the YSI 6025 is malfunctioning.

First, determine whether the wiper system of the probe is working by interfacing the sonde containing the sensor to a computer on a 610 display/logger, beginning a Discrete Sample study, and manually activating the wiper with the appropriate keystroke ("3" for a PC interface, "t" for a 610 interface). Determine if the wiper turns at all, and, if it does, whether it reverses direction and parks approximately 180 degrees from the optical face.

Second, determine the sensitivity of the probe by measuring its sensitivity under factory default conditions in acridine orange dye solution. Prepare a 0.2 mg/L solution of the dye as described in **Section 5, Principles of Operation**. Then place the sonde containing the probe in question into the dye solution. Enter the Calibrate menu and then the Chlorophyll submenu and choose a "1-point Chl ug/L" protocol. Instead of entering a value at the prompt, type the work "uncal" and press **Enter**. This returns the sonde software to the factory default sensitivity. Begin a Discrete Sample study and record the chlorophyll ug/L reading displayed. Finally, place the sonde in deionized water and record the chlorophyll ug/L reading displayed in Discrete Sample.

Record the results of these two tests and report them, along with any other symptoms, to a YSI Customer Service representative.

APPENDIX J SPECIFICATIONS

SONDE SPECIFICATIONS

6600 SONDE

Operating Environment

Medium:	fresh, sea, or polluted water
Temperature:	-5 to +45 °C
Depth:	0 to 656 feet (200 meters)

Storage Temperature: -40 to +60 °C for sonde and all sensors except pH and pH/ORP
-20 to +60 °C for pH and pH/ORP sensors

Material: PVC, Stainless Steel

Maximum Diameter: 3.5 inches (8.9 cm)
Maximum Length: 19.6 inches (49.7 cm) with no depth, 21.6 inches (54.8 cm) with depth
Maximum Weight: 7 pounds (31.8 kg) with depth and batteries but no added bottom weight

Computer Interface: RS-232C, SDI-12

Internal logging memory size: 384 kilobytes (150,000 individual parameter readings)

Power: 8 C-size Alkaline Batteries or External 12 VDC

Battery Life: Approximately 90 days at 20 C at 15 minute logging intervals, a 40 second DO warm up time, and turbidity and/or chlorophyll active.

6920 SONDE

Operating Environment

Medium:	fresh, sea, or polluted water
Temperature:	-5 to +45 °C
Depth:	0 to 200 feet (61 meters)

Storage Temperature: -40 to +60 °C for sonde and all sensors except pH and pH/ORP
-20 to +60 °C for pH and pH/ORP sensors

Material: Polyurethane, PVC, Stainless Steel

Maximum Diameter: 2.9 inches (7.4 cm)
Maximum Length: 18.0 inches (45.7 cm)
Maximum Weight: 3.7 pounds (1.7 kg) with 6026 wiping turbidity sensor and without cable

Computer Interface: RS-232C, SDI-12

Internal logging memory size: 384 kilobytes (150,000 individual parameter readings)

Power: 8 AA-size Alkaline Batteries or External 12 VDC

Battery Life: Approximately 30 days at 20 °C at 15 minute logging intervals, a 40 second DO warm up time and turbidity or chlorophyll active

6820 SONDE

Operating Environment

Medium: fresh, sea, or polluted water
Temperature: -5 to +45 °C
Depth: 0 to 200 feet (61 meters)

Storage Temperature: -40 to +60 °C for sondes and all sensors except pH and pH/ORP
-20 to +60 for pH and pH/ORP

Material: PVC, Stainless Steel

Maximum Diameter: 2.9 inches (7.4 cm)
Maximum Length: 13.6 inches (34.5 cm)
Maximum Weight: 3.4 pounds (1.5 kg) without cable and with 6036 turbidity sensor.

Internal logging memory size: 384 kilobytes (150,000 individual parameter readings)

Computer Interface: RS-232C, SDI-12
Power: External 12 VDC (8 to 13.8 VDC)

600XLM SONDE

Operating Environment

Medium: fresh, sea, or polluted water
Temperature: -5 to +45 °C
Depth: 0 to 200 feet (61 meters)

Storage Temperature: -40 to +60 °C for sonde and all sensors except pH and pH/ORP
-20 to +60 °C for pH and pH/ORP sensors

Material: PVC, Stainless Steel

Diameter: 1.7 inches (4.4 cm)
Length: 21.3 inches (54.1 cm) with no depth; 23.3 inches (59.2 cm) with depth (top of connector to bottom of standard weight)
Weight: 1.48 pounds (0.67 kg) (with batteries, without bottom weight)

Computer Interface: RS-232C, SDI-12

Internal logging memory size: 384 kilobytes (150,000 individual parameter readings)

Power: 4 AA-size Alkaline Batteries or External 12 VDC

Battery Life: 25 to 30 days at 20 C with a 15 minute logging interval and a 40 second dissolved oxygen warm up

600XL SONDE

Operating Environment

Medium: fresh, sea, or polluted water
Temperature: -5 to +45 °C
Depth: 0 to 200 feet (61 meters)

Storage Temperature: -40 to +60 °C for sonde and all sensors except pH and pH/ORP
-20 to +60 °C for pH and pH/ORP sensors

Material: Polyurethane, PVC, Stainless Steel

Maximum Diameter: 1.6 inches (4.06 cm)
Maximum Length: 20.75 inches (52.7 cm)
Maximum Weight: 4.9 pounds (2.22 kg)

Internal logging memory size: 384 kilobytes (150,000 individual parameter readings)

Computer Interface: RS-232C, SDI-12

Power: External 12 VDC (8 to 13.8 VDC)

600R SONDE

Operating Environment

Medium: fresh, sea, or polluted water
Temperature: -5 to +45 °C
Depth: 0 to 200 (61 meters)

Storage Temperature: -40 to +60 °C (without pH installed)
-20 to +60 ° C (with pH installed)

Material: PVC, Stainless Steel

Diameter: 1.6 inches (4.06 cm)
Length: 14.25 inches (36.20 cm)

Weight: 1.43 pounds (0.65 kg)

Computer Interface: RS-232C, SDI-12

Internal logging memory size: 384 kilobytes (150,000 individual parameter readings)

Power: External 12 VDC (8 to 13.8 VDC)

SENSOR SPECIFICATIONS

The following are typical performance specifications for each sensor.

Non-Vented Level – Deep
Sensor Type.....Stainless steel strain gauge
Range.....0 to 656 feet (200 m)
Accuracy.....+/- 1 ft (0.3 m)
Resolution.....0.001 ft (0.001 m)

Non-Vented Level - Medium
Sensor Type.....Stainless steel strain gauge
Range.....0 to 200 ft (61 m)
Accuracy.....+/- 0.4 ft (0.12 m)
Resolution.....0.001 ft (0.001 m)

Non-Vented Level - Shallow
Sensor Type.....Stainless steel strain gauge
Range.....0 to 30 ft (9.1 m)
Accuracy ..... +/- 0.06 ft (0.018 m)
Resolution.....0.001 ft (0.001 m)

Vented Level - Shallow
Sensor Type.....Stainless steel strain gauge
Range.....0 to 30 ft (9.1 m)
Accuracy, 0-10ft .....+/- 0.01 ft (0.003 m)
Accuracy, 10-30ft.....+/- 0.06 ft (0.018 m)
Resolution.....0.001 ft (0.001 m)

Temperature
Sensor Type.....Thermistor
Range.....-5 to 45 °C
Accuracy.....+/- 0.15 °C
Resolution.....0.01 °C
Depth……200 meters

Dissolved Oxygen, % saturation
Sensor Type.....Rapid Pulse - Clark type, polarographic
Range.....0 to 500 % air saturation

Accuracy.....0-200 % air saturation, +/- 2 % of the reading or 2 % air saturation, whichever is greater 200-500 % air saturation, +/- 6 % of reading
Resolution.....0.1 % air saturation
Depth……200 meters

Dissolved Oxygen, mg/L (Calculated from % air saturation, temperature and salinity)
Sensor Type..... Rapid Pulse - Clark type, polarographic
Range.....0 to 50 mg/L
Accuracy.....0 to 20 mg/L, +/- 2 % of the reading or 0.2 mg/L, whichever is greater
20 to 50 mg/L, +/- 6 % of the reading
Resolution.....0.01 mg/L
Depth……200 meters

Salinity
Sensor Type.....Calculated from conductivity and temperature
Range.....0 to 70 ppt
Accuracy.....+/- 1.0% of reading or 0.1 ppt, whichever is greater
Resolution.....0.01 ppt

pH
Sensor Type.....Glass combination electrode
Range.....0 to 14 units
Accuracy.....+/- 0.2 units
Resolution.....0.01 units
Depth……200 meters

ORP
Sensor type..... Platinum button
Range.....-999 to +999 mV
Accuracy.....+/-20 mV
Resolution.....0.1 mV
Depth……200 meters

Turbidity
Sensor type..... Optical, 90 ° scatter, with mechanical cleaning
Range..... 0 to 1000 NTU
Accuracy.....+/- 5% reading or 2 NTU (whichever is greater)
Resolution.....0.1 NTU
Depth……66 meters

Chlorophyll
Sensor type..... Optical, fluorescence, with mechanical cleaning
Range..... 0 to 400 µg/L Chl; 0-100 Percent Full Scale (% FS) Fluorescence Units
Accuracy..... No specification provided
Resolution.....0.1 µg/L Chl; 0.1 % FS
Depth……66 meters

Conductivity*
Sensor Type.....4 electrode cell with autoranging
Range.....0 to 100 mS/cm
Accuracy.....+/- 0.5% of reading + 0.001 mS/cm
Resolution.....0.001 mS/cm to 0.1 mS/cm (range dependent)
Depth……200 meters

Nitrate-Nitrogen
Sensor Type.....Ion-selective electrode
Range.....0-200 mg/L-N
Accuracy.....+/- 10% of reading or 2 mg/L (whichever is greater)
Resolution.....0.001 mg/L-N to 1 mg/L-N (range dependent)
Depth……15 meters

Ammonium-Nitrogen
Sensor Type.....Ion-selective electrode
Range.....0-200 mg/L-N
Accuracy.....+/- 10% of reading or 2 mg/L (whichever is greater)
Resolution.....0.001 mg/L-N to 1 mg/L-N (range dependent)
Depth……15 meters

Ammonia-Nitrogen
Sensor Type.....Calculated from ammonium, pH and temperature
Range.....0-200 mg/L-N
Accuracy.....+/- 10% of reading or 2 mg/L (whichever is greater)
Resolution.....0.001 mg/L-N to 1 mg/L-N (range dependent)
Depth……15 meters

Chloride
Sensor Type.....Solid state ion-selective electrode
Range.....0-1000 mg/L
Accuracy.....+/- 15% of reading or 5 mg/L (whichever is greater)
Resolution.....0.001 mg/L to 1 mg/L (range dependent)
Depth……15 meters

SOFTWARE SPECIFICATIONS

EcoWatch for Windows (included)

IBM PC compatible computer with 3 1/2 inch floppy disk drive and with a 386 processor (or better) running Windows version 3.1 (or later).
Minimum RAM requirement: 4 megabytes

PC6000 (optional)

IBM PC compatible computer, 3 1/2 or 5 1/4 inch, high or low density floppy disk drive.
Minimum RAM requirement: 256 K bytes Optional graphic adapter for plotting

* Report outputs of specific conductance (conductivity corrected to 25 C), resistivity, and total dissolved solids are also provided. These values are automatically calculated from conductivity according to algorithms found in *Standard Methods for the Examination of Water and Wastewater* (Ed 1989).

YSI *incorporated*

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