6000UPG

Multi-Parameter
Water Quality Monitor

Instruction Manual

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YSI

®

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1. INTRODUCTION

1.1 DESCRIPTION

The 6000UPG Environmental Monitoring System is a multiparameter, water quality measurement, and data logging system. It is intended for use in research, assessment, and regulatory compliance applications.

Measurement parameters include:

- Dissolved Oxygen
- Conductivity
- Specific Conductance
- Salinity
- Total Dissolved Solids
- Resistivity
- Temperature
- pH
- ORP
- Depth
- Level
- Ammonium/Ammonia
- Nitrate
- Turbidity

The 6000UPG is ideal for profiling and monitoring water conditions in lakes, rivers, wetlands, estuaries, coastal waters, and monitoring wells. It can be left unattended for weeks at a time with measurement parameters sampled at a user-defined setup interval and data securely saved in the unit's internal memory. The 6000UPG can be used 500 feet (152 meters) below the surface of the water, or in as little as a few inches of water. The fast sensor response of the 6000UPG and its built-in data logging make it ideal for vertical profiling. Its small size means it can fit down 4 inch (10.2 cm) diameter monitoring wells.

A patented Rapid Pulse Dissolved Oxygen Sensor exhibits low stirring dependence and, therefore provides accurate results without an expensive and bulky stirrer. Because stirring is not required, battery life is extended. In addition, because of the nature of the technology, sensor drift caused by passive fouling is minimized.

The Model 6000UPG is designed to house 4 field-replaceable probes (6 sensors) and the option to add a depth sensor module to the sonde body. If necessary, the dissolved oxygen-conductivity-temperature, pH, ammonium, nitrate ORP, and turbidity sensors are quickly replaced in the field.

The 6000UPG communicates with an ASCII terminal or a computer with a terminal emulation program. Every 6000UPG comes with IBM-compatible PC-based software for simple and convenient setup and data handling. Reports and plots are automatically generated and their presentation easily customized. Data is easily exported to any spreadsheet program for more sophisticated data processing.

The RS-232C and SDI-12 interfaces provide maximum versatility for system networking and real time data collection. Several 6000UPG units are easily installed in a vertical string providing valuable water quality data at a variety of depths. For real time results, the 6000UPG can interface to radio telemetry systems and satellite, telephone, or cellular phone data collection platforms. In addition, the unit can be used with our 610-D or 610-DM display/logger for profiling or spot sampling applications. The 6000UPG is equipped with sensor and communication circuitry to eliminate ground loop interference.

When the 6000UPG is factory configured for internal power, it operates using eight C-size alkaline batteries. These batteries are easily replaced in the field, without disassembly of the unit. The minimal power requirements of the Rapid Pulse Dissolved Oxygen Sensor combined with state-of-the-art electronic circuits and software can provide up to 90 days of battery life during normal use, depending on the activated sensor configuration.

The 6000UPG comes standard with 256 kilobytes of memory; this is enough to store 150,000 individual parameter readings for a typical deployment.

Optional cables are available for interfacing the 6000UPG with a computer, terminal, or display/logger. These cables are waterproof at the sonde connection and can be used in the lab or field.

See Appendix D for a complete list of accessories and calibration reagents.

1.2 GENERAL SPECIFICATIONS

See also Section 1.3 Sensor Specifications.

Operating Environment
Medium: fresh, sea, or polluted water
Temperature: -5 to +45 °C
Depth: 0 to 500 feet (152 meters)

Storage Temperature: -40 to +60 °C

Material: PVC, Stainless Steel

Dimensions
Diameter: 3.5 inches (8.9 centimeters)
Length: 19.5 inches (49.5 centimeters)
Weight: 6.5 pounds (3.0 kilograms) , with batteries

Computer Interface
RS-232C
SDI-12

Software
PC6000
> IBM PC compatible computer, 3 1/2 or 5 1/4 inch, high or low density disk drive.
> Minimum RAM requirement: 256 kilobytes
> Optional graphic adapter for plotting

Ecowatch for Windows (optional)
> IBM PC compatible computer with 3 1/2 inch disk drive and with a 386 processor (or
> better) running Windows version 3.1 (or later).
> Minimum RAM requirement: 4 megabytes

Internal logging memory size (typical deployment)
256 kilobytes (150,000 individual parameter readings)
512 kilobytes (300,000 individual parameter readings)

Power (two options)
12 VDC (8 C-size Alkaline Batteries)
External 12 VDC

Battery Life
120 days without dissolved oxygen and turbidity sensor activation
90 days without turbidity sensor activation
45 days with dissolved oxygen and turbidity sensor activation

1.3 SENSOR SPECIFICATIONS

The following are typical performance specifications for each sensor.

Depth - Deep
Sensor Type...........Stainless steel strain gauge
Range.....................0 to 500 ft (152 m)
Accuracy................+/- 1 ft (0.3 m)
Resolution.............0.001 ft (0.001 m)

Depth - 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)

Depth - Shallow
Sensor Type..............Stainless steel strain gauge
Range........................0-30 ft (9.1 m)
Accuracy .... +/- 0.06 ft (0.018 m)
Range........................0.001 ft (0.001 m)

Temperature
Sensor Type...........Thermistor
Range.....................-5 to 45 °C
Accuracy................+/- 0.15 °C (optional configuration at +/- 0.05 °C)
Resolution.............0.01 °C

Dissolved Oxygen % saturation
Sensor Type...........Rapid Pulse - Clark-type, polarographic
Range.....................0 to 200 % air saturation
Accuracy................+/- 2 % air saturation
Resolution.............0.1 % air saturation

Dissolved Oxygen mg/L (Calculated from % air saturation, temperature and salinity)
Sensor Type............ Rapid Pulse - Clark-type, polarographic
Range.....................0 to 20 mg/L
Accuracy................+/- 0.2 mg/L
Resolution.............0.01 mg/L

Conductivity[*]
Sensor Type...........4 electrode cell with autoranging
Range.....................0 to 100 mS/cm
Accuracy................+/- 0.5% of reading + 0.001 mS/cm
Resolution.............0.01 mS/cm or 1 uS/cm

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* 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).

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.....................2 to 14 units
Accuracy................+/- 0.2 units
Resolution.............0.01 units

pH - Low Ionic Strength

Sensor Type...........Glass combination electrode with open junction and low impedance glass
Range.....................2 to 14 units
Accuracy................+/- 0.2 units
Resolution..............0.01 units

ORP
Sensor type............ Platinum ring
Range.....................-999 to +999 mV
Accuracy.................+/-20 mV
Resolution...............0.1 mV

Nitrate-Nitrogen
Sensor Type...........Ion selective electrode
Range.....................0 to 200 mg/L-N
Accuracy................ +/- 10% of reading or 2 mg/L, whichever is greater
Resolution.............0.1 mg/L

Ammonium-Nitrogen
Sensor Type...........Ion selective electrode
Range.....................0 to 200 mg/L-N
Accuracy................ +/- 10% of reading or 2 mg/L, whichever is greater
Resolution..............0.1 mg/L

Ammonia
Sensor Type...........Calculated from ammonium, pH, and temperature
Range.....................0 to 200 mg/L-N
Accuracy................ +/- 10% of reading or 2 mg/L, whichever is greater
Resolution..............0.1 mg/L

Turbidity
Sensor Type...........Optical, 90 degree scatter, mechanical cleaning
Range.....................0 to 1000 NTU
Accuracy................ +/- 5% of reading or 2 NTU, whichever is greater
Resolution.............0.1 NTU

1.4 HOW TO USE THIS MANUAL

The manual is organized to let you quickly understand and operate the 6000UPG system. 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.

Sections 2 and 3 help you get started, providing initial setup information as well as calibration and basic operating instructions. Sections 4 and 5 provide detailed information on the Sonde software structure and YSI PC6000 software, respectively. PC6000 is PC-based software designed to help the user to easily generate reports and plots from the data collected by the sonde. Sections 6-8 address principles of operation, sonde and sensor maintenance, and system troubleshooting. Section 9 provides more detailed information on communications protocols. Section 10 provides service and repair information. The appendices (A-H) provide information on safety, warranty, accessories, options, storage recommendations, and more.

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

The 6000UPG can be purchased with or without internal battery power capability. Additionally, all probes, cables and accessories can be ordered as options or ordered together as a system.

If you have any questions about this product or its application, please contact our customer service department or authorized dealer for assistance. See Appendix C for contact information.

2. GETTING STARTED

This section is designed to quickly familiarize you with the hardware and software components of the 6000UPG sonde and its accessories. You will then proceed to sensor installations, cable connections, software installation and finally basic communication with the 6000UPG Sonde. Diagrams, menu flow charts and basic written instructions will guide you through basic hardware and software setup. For the first time user, we encourage the use a personal computer with PC6000 software during this initial setup procedure.

By the end of Section 2 you will have...
❏ Installed sensors in your sonde
❏ Installed PC6000 software in your PC
❏ Established communication between the sonde software and PC software
❏ Enabled appropriate sensors
❏ Assigned appropriate report parameters and units

Successful completion of the above list is essential for you to continue on to Section 3 which focuses on performing calibrations and making measurements.

2.1 UNPACKING

Remove the instrument from the shipping container. Be careful not to discard any parts or supplies. Check off all items on the packing list and inspect all assemblies and components for damage. If any parts are damaged or missing, contact your representative immediately. If you do not know from which dealer your 6000UPG was purchased, refer to Appendix C for contact information.

NOTE: Reagents for the 6000UPG are not packaged in the same carton as the instrument. These materials must be ordered separately and will arrive in a separate package.

2.2 SYSTEM CONFIGURATION

There are a number of ways in which you may configure the 6000UPG Sonde with various computers, terminals, and data collection devices. You should think about your particular application needs and then make certain that you have all of the components you need to make your system work. Below is a list of possible configurations that may be of interest to you. Each is depicted in diagrammatic sketches on the next 3 pages.

❏ 6000UPG Sonde to YSI 610 Display/Logger
❏ 6000UPG Sonde to Portable Computer
❏ 6000UPG Sonde to Data Collection Platform
❏ 6000UPG Sonde to Lab Computer
❏ Upload Data from 6000UPG Sonde to YSI 610-DM
❏ Upload Data Files from YSI 610 to Lab Computer

6000UPG Sonde to 610 Display/Logger

6098 MS-8 Adapter

610-D or 610-DM

MS-8

Cable
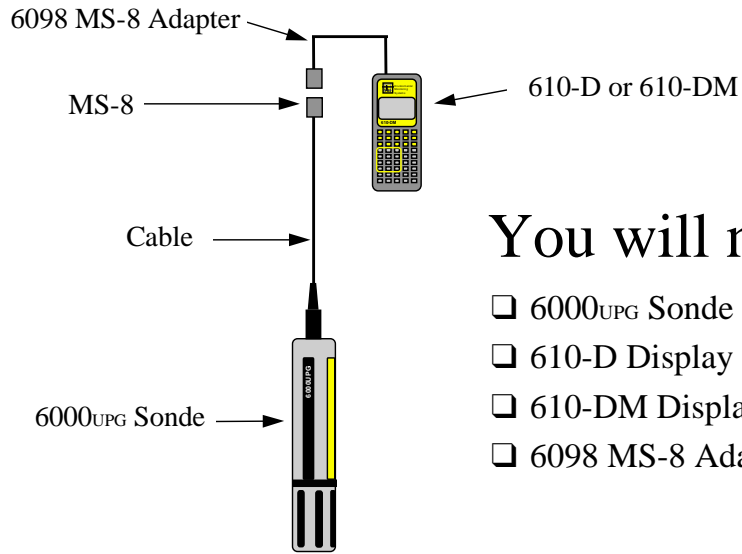
You will need...

❑ 6000UPG Sonde
❑ 610-D Display <u>or</u>
❑ 610-DM Display/Logger
❑ 6098 MS-8 Adapter for 610

6000UPG Sonde

YSI 610's operate on rechargeable batteries.
Each 610 comes with a 110 VAC Wall Socket Charger Unit.

6000UPG Sonde to Portable Computer

DB-9

6095B

Adapter

MS-8

Cable
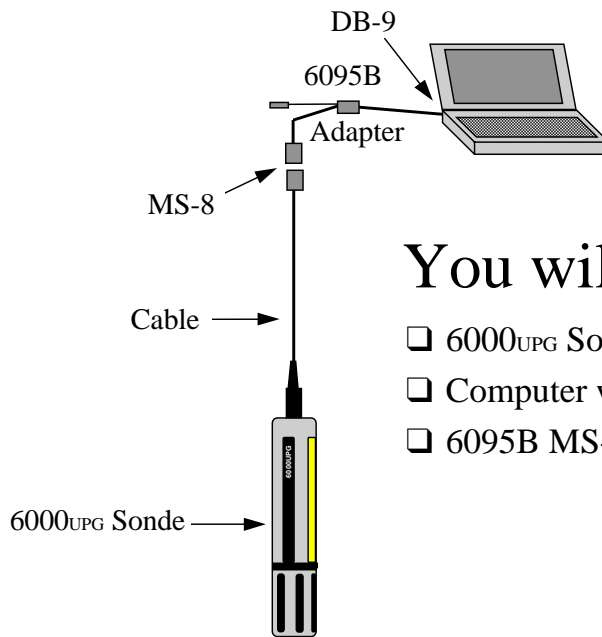
You will need...

❑ 6000UPG Sonde
❑ Computer with Com Port
❑ 6095B MS-8/DB-9 Adapter

6000UPG Sonde

6000UPG Sonde to Data Collection Platform

DCP

6096 MS-8 Adapter with Flying Leads

MS-8

Cable
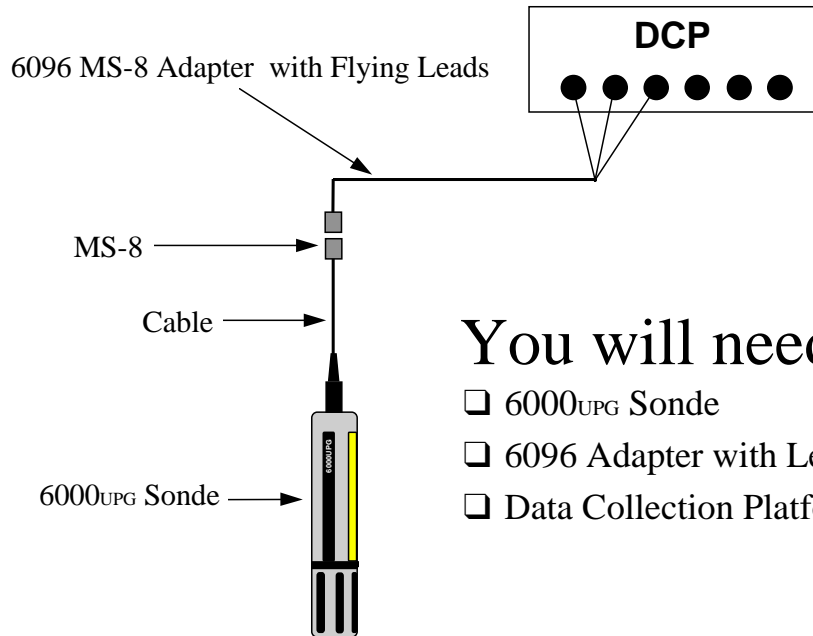
You will need...

❑ 6000UPG Sonde

❑ 6096 Adapter with Leads

❑ Data Collection Platform
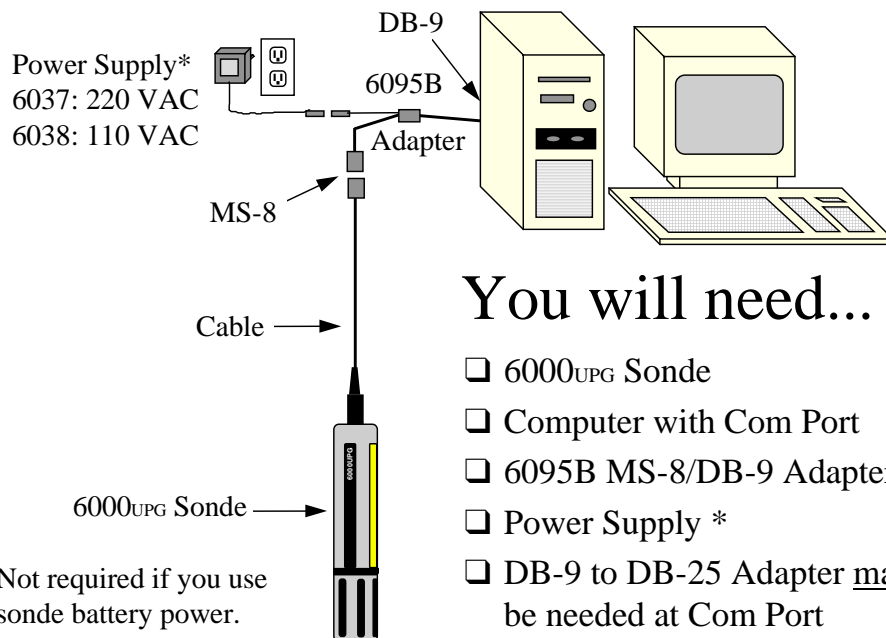
6000UPG Sonde

6000UPG Sonde to Lab Computer

DB-9

Power Supply*
6037: 220 VAC
6038: 110 VAC

6095B

Adapter

MS-8

Cable

You will need...

❑ 6000UPG Sonde

❑ Computer with Com Port

❑ 6095B MS-8/DB-9 Adapter

❑ Power Supply *

❑ DB-9 to DB-25 Adapter may
    be needed at Com Port

6000UPG Sonde

* Not required if you use
  sonde battery power.

Upload Data from 6000UPG Sonde to 610-DM

6098 MS-8 Adapter

610-DM

MS-8

Cable
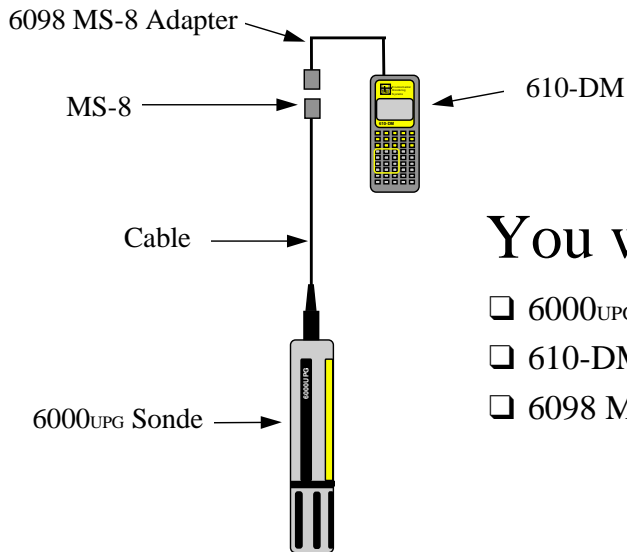
You will need...

❑ 6000UPG Sonde

❑ 610-DM Display/Logger

❑ 6098 MS-8 Adapter for 610

6000UPG Sonde

YSI 610's operate on rechargeable batteries.
Each 610 comes with a 110 VAC Wall Socket Charger Unit.

Upload 610 Data Files to Lab Computer

Null Modem Cable

DB-9

6099 DB-9 Adapter

DB-9
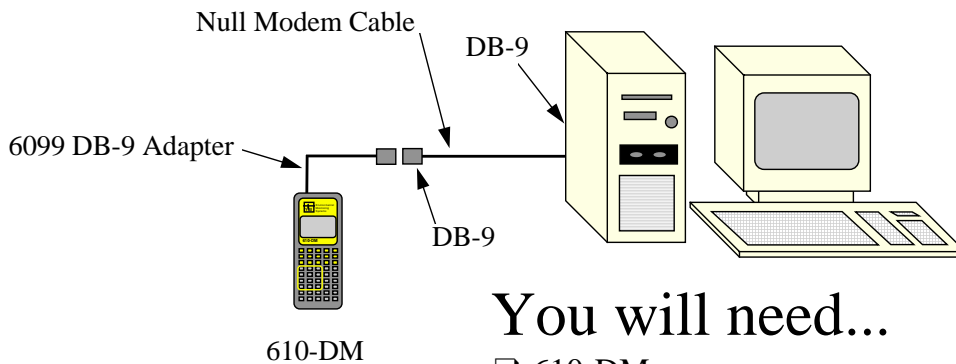
610-DM

You will need...

❑ 610-DM

❑ 6099 DB-9 Adapter

❑ Null Modem Cable

❑ DB-9 to DB-25 Adapter may
   be needed at Com Port

2.3 SONDE SETUP

In the following section, you will be provided with step-by-step instructions on how to get your 6000UPG up and running. We recommend following the steps in the order listed. However, depending on your sonde configuration and the optional sensors which you have purchased, some of the steps may not apply to your setup. If so, simply skip to the next step in the protocol which is relevant to your application.

STEP 1. INSTALL YSI 6030 DO/COND/TEMP PROBE

Follow these instructions to prepare your new probe and install it in the Model 6000UPG.

1. Open the membrane kit and prepare the electrolyte. Dissolve the KCl crystals in the dropper bottle by filling it to the neck with distilled water and shaking until the solid is dissolved. Insure that the crystals are fully dissolved before use.

Add distilled water
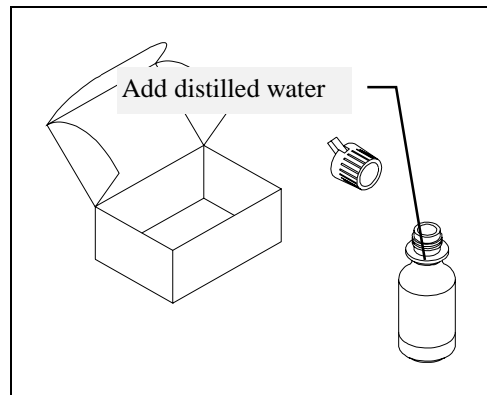
2. Remove the two protective caps and the dry membrane from the 6030 probe.

NOTE: Your probe is shipped with a protective dry membrane on the dissolved oxygen sensor tip. It is very important not to scratch or contaminate the sensor tip. Handle the new probe with care. Avoid touching or accidentally hitting the sensor tip.

Protective Caps

Protective Dry Membrane
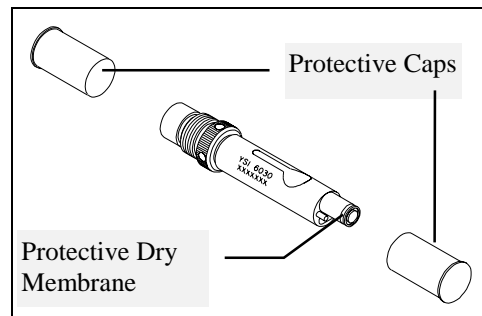
3. Follow the procedure described below to install a new membrane on the dissolved oxygen sensor tip.

A. 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.

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

C. 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.

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

E. 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.

F. Trim off any excess membrane with a sharp knife or scissors. Make sure the stainless steel temperature sensor is not covered by excess membrane. Being careful not to get water in the connector, rinse off the excess KCl solution.

4. Using the hex driver supplied in the 6040 Maintenance Kit, remove the probe guard mounting screws from the sonde. Set the probe guard aside.

NOTE: *Do not remove the two allen screws above the guard.*
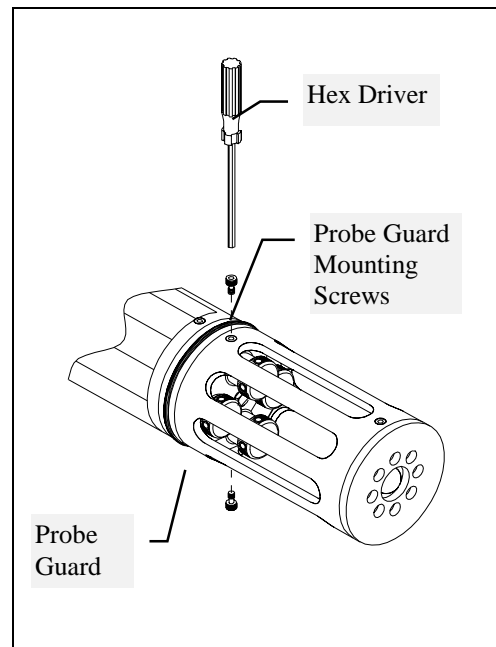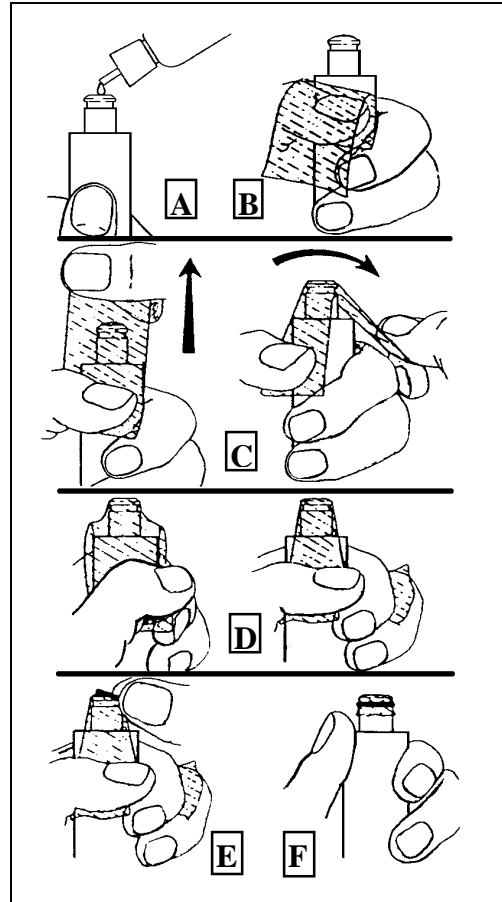
5. Locate the plug which seals the DO.C.T. port on the sonde. Using the hex driver to assist you, remove the plug.
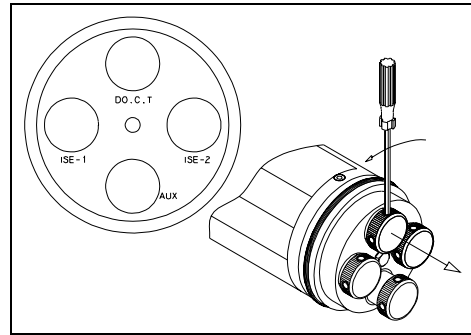
6. Install the 6030 probe into the sonde as described below.

A. Apply a very thin coat of O-ring lubricant (supplied in the 6040 Maintenance Kit) to the O-ring on the connector side of the probe. Insert the probe in the port marked DO.C.T.

B. With the connectors aligned, screw down the probe nut, making sure that the probe and sonde connectors are fully meshed. Use the hex driver to assist you in tightening the nut. *DO NOT OVER TIGHTEN*.
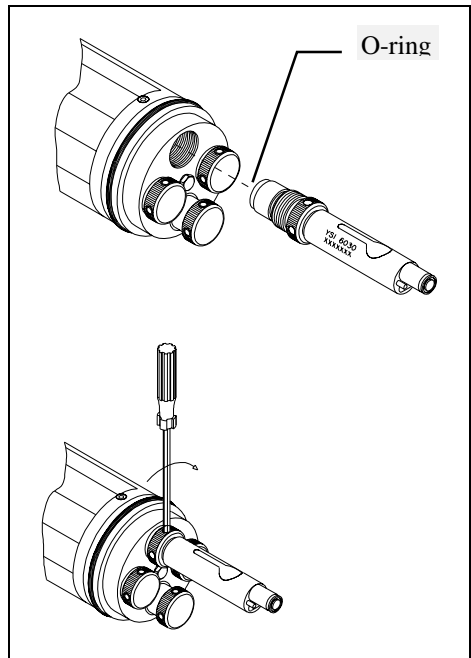
7. Replace the probe guard and tighten the probe guard mounting screws.
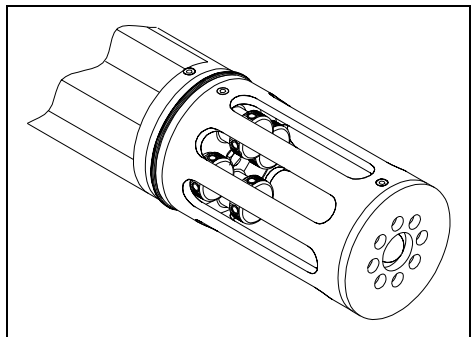
STEP 2. INSTALL OTHER PROBES

If you have purchased any optional YSI probes, follow instructions provided below for all items other than the 6029 conductivity/temperature sensor which is installed in an identical fashion to the 6030.   The 6031 pH, 6032 ORP, 6033 low ionic strength pH, 6084 nitrate, and 6083 ammonium probes can be ordered as options and do not require factory installation (see Section 4.7 for software setup). The 6026 turbidity probe is installed by the user according to its accompanying instructions, but requires an additional PCB which must be factory installed. The depth sensors are factory installed options.

> **YSI 6031 pH Probe**
> **YSI 6032 ORP Probe**
> **YSI 6033 Low Ionic Strength pH Probe**

Follow these instructions to prepare your new probe and install it in the 6000UPG.

NOTE: Instructions for preparation of use, maintenance and storage are included with each electrode.

1. Remove the storage bottle or hydrating cap and rinse the glass portion of the electrode with distilled water.
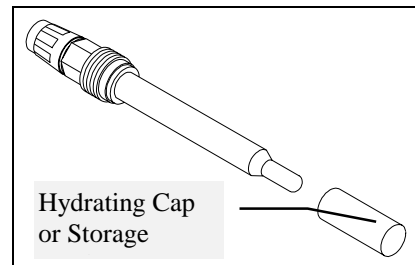
Hydrating Cap
or Storage

2. Apply a very thin coat of O-ring lubricant (supplied in the YSI 6040 Maintenance Kit) to the O-ring on the glass shaft of the new electrode. Insert the electrode into the probe housing and hand tighten.

DO NOT OVER TIGHTEN.
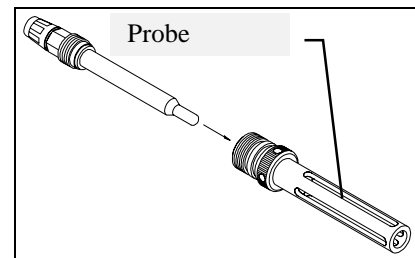
Probe

3. Using the hex driver (supplied in the YSI 6040 Maintenance Kit), remove the probe guard mounting screws from the sonde. Set the probe guard and mounting screws aside.

CAUTION:
Do not remove the two allen screws above the guard.

Do Not Remove These Screws

Guard
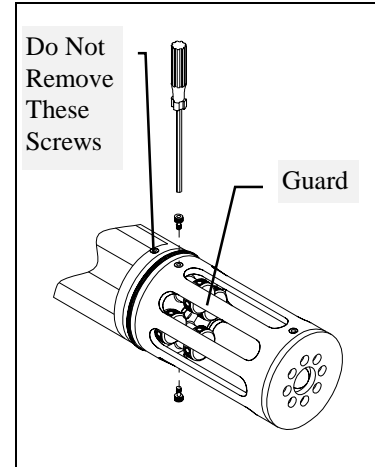
4. Locate the plug which seals the port ISE-1 or ISE-2 on the sonde. pH probes must be installed in the ISE-1 port; ORP probes must be installed in ISE-2 port.

Using the hex driver to assist you, remove the plug.
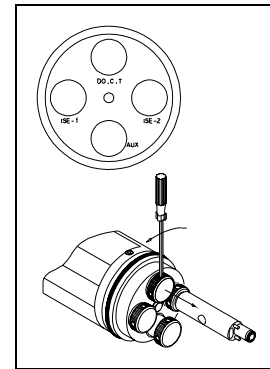
5. Install the 6031, 6032 or 6033 probes into the sonde as described below.

A. Remove the connector cap from the electrode and check to be certain the electrode is still firmly seated in the probe housing, as described in Step 2.

B. Apply a very thin coat of O-ring lubricant (supplied in the YSI 6040 Maintenance Kit) to the O-ring on the connector side of the probe and to the O-ring on the probe housing. Insert the probe assembly into the selected sonde port.

C. Screw the probe assembly into the sonde. Use the hex driver to assist you in tightening the probe into the sonde.

DO NOT OVER TIGHTEN.

Hex Driver
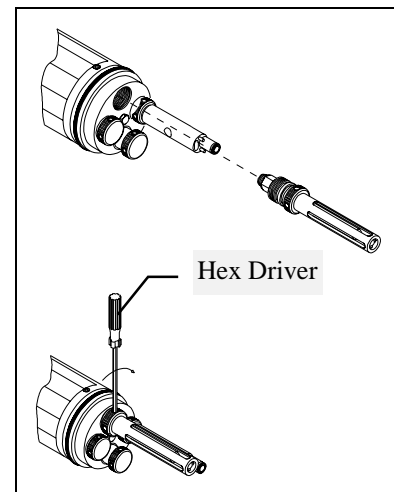
YSI 6083 Ammonium Probe
YSI 6032 Nitrate Probe

Follow these instructions to prepare your new probe and install it in the Model 6000UPG.

NOTE: Instructions for preparation of use, maintenance and storage are included with each electrode.

1. Note that the ammonium and nitrate probes consist of two parts: A probe body and a membrane module which threads into the end of the probe body.
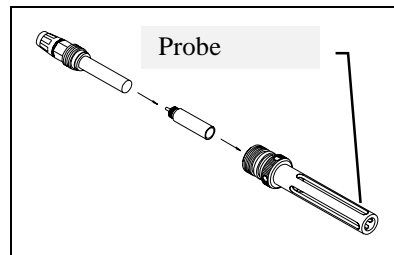
2. Apply a very thin coat of O-ring lubricant (supplied in the YSI 6040 Maintenance Kit) to the O-ring on membrane module. Thread the membrane module into the end of the probe body and tighten by hand until the units mesh completely.

Do not over tighten and in no case ever use any tools such as pliers in this operation.

3. Apply a very thin coat of O-ring lubricant (supplied in the YSI 6040 Maintenance Kit) to the O-ring on the plastic shaft of the new electrode. Insert the electrode into the probe housing and hand tighten.

DO NOT OVER TIGHTEN.

4. Locate the plug which seals the port ISE-2 on the sonde. The ammonium and nitrate sensors must be installed in this port.

Using the hex driver to assist you, remove the plug.
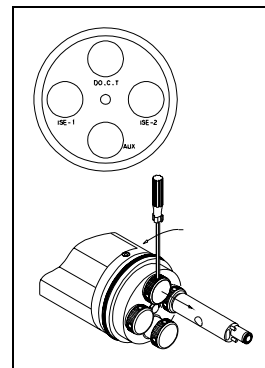
5. Install the 6083 or 6084 probe into the sonde as described below.

A. Apply a very thin coat of O-ring lubricant (supplied in the YSI 6040 Maintenance Kit) to the O-ring on the connector side of the probe and to the O-ring on the probe housing. Insert the probe assembly into the selected sonde port.

B. Screw the probe assembly into the sonde. Use the hex driver to assist you in tightening the probe into the sonde. *DO NOT OVER TIGHTEN.*
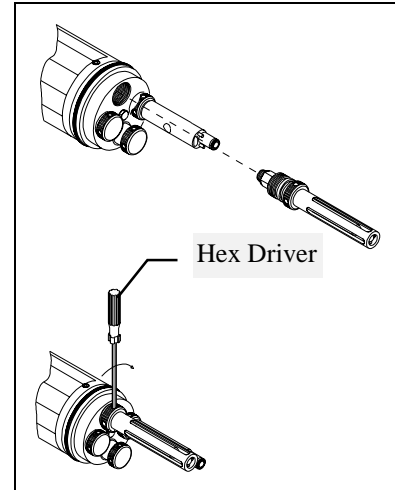
Hex Driver

YSI 6026 Turbidity Probe

1. Remove the turbidity probe from its box and any protective caps from the probe.

2. Locate the plug which seals the auxiliary (AUX) port on the sonde. Using the hex driver to assist you, remove the plug.
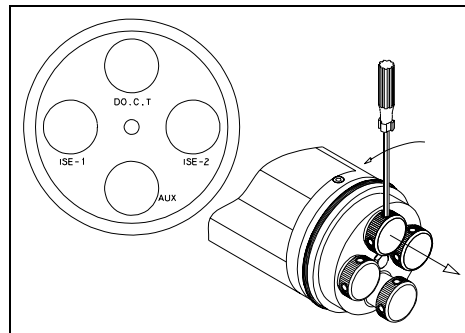

3. Install the 6026 probe into the sonde as described below.

A. Apply a very thin coat of O-ring lubricant (supplied in the 6040 Maintenance Kit) to the O-ring on the connector side of the probe. Insert the probe in the port marked AUX.

B. With the connectors aligned, screw down the probe nut, making sure that the probe and sonde connectors are

O-ring
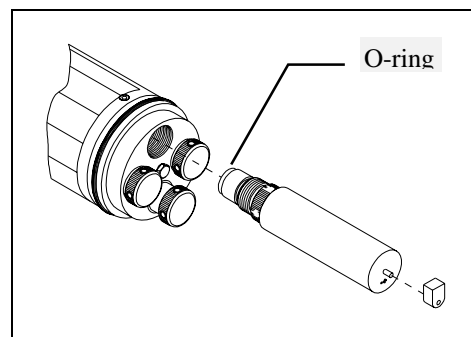
fully meshed. Use the hex driver to assist you in tightening the nut.

DO NOT OVER TIGHTEN.

After all probes have been installed, replace the probe
guard and tighten the probe guard mounting screws.
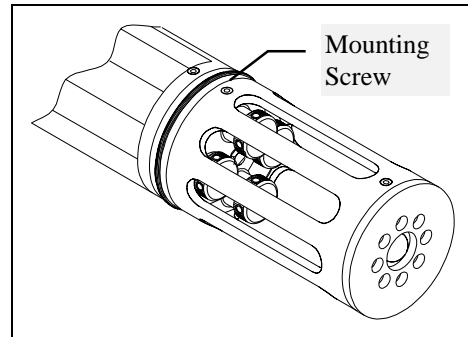
STEP 3. INSTALL BATTERIES

NOTE: Some 6000UPGs are not configured with internal battery capability. If the 6000UPG you have purchased is configured to operate from internal batteries, it will have a battery compartment and battery lid as illustrated below. *If your 6000UPG does not have a battery compartment, ignore these battery installation instructions.*

Your first set of batteries is supplied with the instrument. Install 8 C-size alkaline batteries as follows:

Use the hex driver, supplied in the 6040 Maintenance Kit, to 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.

NOTE: Observe the correct polarity before installing the batteries into the battery chamber.

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 located in the middle of the side of the battery lid.

Apply a very thin coat of O-ring lubricant (supplied in the 6040 Maintenance Kit) to both battery chamber O-rings.

Return the battery lid and tighten the screws. *DO NOT OVER TIGHTEN.*
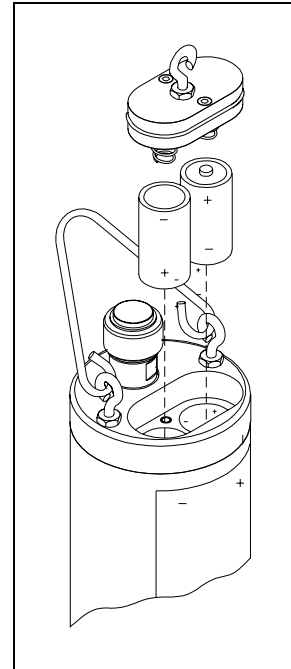
STEP 4. ATTACH CABLE

Remove the waterproof cap from the sonde connector and set it aside for later reassembly. Connect a PC interface cable to the sonde connector. A built-in key will ensure proper pin alignment. Rotate the cable connector gently until the key engages and then tighten the connectors together by rotating clockwise. Note that the attachment is by hand only! No tools are required nor should they be used. Attach the strain relief connector to the sonde handle. Rotate the strain relief connector nut to close the connector's opening.

The other end of the cable is a military-style 8-pin connector. This connector plugs directly into the 610-D and 610-DM display loggers. Most other applications will require the use of an adapter. For example, to connect the 6000UPG to a computer, use a YSI 6095b MS-8 to DB-9 adapter.
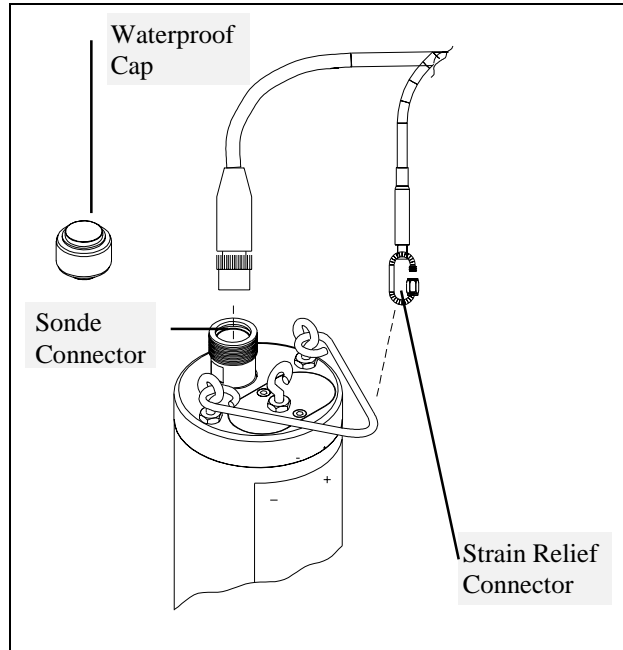
STEP 5. REVIEW POWER OPTIONS

Some type of external power supply can be used to power the 6000UPG sonde in lieu of batteries. For laboratory setup and calibration with the sonde interfaced to a computer, the YSI 6038 (110 VAC) or 6037 (220 VAC) can be employed. Most adapters include a short pigtail for power that plugs into the power supply. After attaching the three pin connector on the power supply to the pigtail, simply plug the power supply into the appropriate outlet. If you have purchased a 610-series display/logger for use with your 6000UPG, attachment of the cable to the 610 will allow your sonde to be powered from the batteries in the display/logger or from the 610 power supply if the 610 internal batteries are not fully charged. However, the 6000UPG circuitry will place a substantial current draw on the 610 batteries resulting in less usable battery life than for other YSI instruments such as the 600, 600XL, and 6000UPG. For this reason, we recommend that batteries be installed in the 6000UPG if a 610 is used as the terminal.

See pages 2-2 to 2-4 for specific information on cables, adapters and power supplies required for connecting your 6000UPG to various devices.

STEP 6. REVIEW SONDE/COMPUTER INTERFACE

The system configuration best suited for initial setup is shown in the diagram to the right.

Below we will describe how to install PC6000 software on your computer and communicate with the Sonde software.

If you have purchased a YSI 610 hand-held display/logger, refer to the 610 manual which was enclosed with the 610 unit.

Note that the power supply is optional -- the unit may be powered by internal, user-installed batteries.

6000ᴜᴘɢ Sonde to Lab Computer

DB-9
Power Supply*
6037: 220 VAC
6038: 110 VAC
6095B
Adapter
MS-8
Cable
6000ᴜᴘɢ Sonde
* Not required if you use sonde battery power.

You will need...

❏ 6000ᴜᴘɢ Sonde
❏ Computer with Com Port
❏ 6095B MS-8/DB-9 Adapter
❏ Power Supply *
❏ DB-9 to DB-25 Adapter <u>may</u> be needed at Com Port
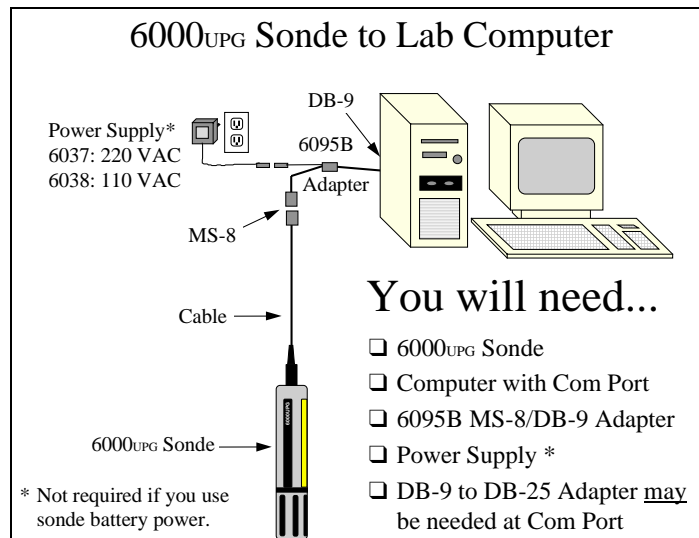
Your 6000ᴜᴘɢ is now physically set up for use. Proceed to the next section on software installation.

2.4 SOFTWARE INSTALLATION

PC6000 software is provided with the 6000ᴜᴘɢ and is found on a disk in the back of this instruction manual. Use this software with an IBM-compatible PC with at least 256KB of RAM and DOS 3.0 or later. If your system is not IBM-compatible, use any terminal emulation program with your computer.

Insert the disk into your disk drive. At the C:\ prompt, type the letter of the drive in which the program disk was inserted followed by a colon, then press Enter.

Example: A: [Enter**]**

To install PC6000 software execute the following command from the DOS prompt:
INSTALL *<destination>*
where destination is the drive and directory in which you want the PC6000 files to be installed.

For example, the command: **INSTALL C:\PC6000** will install the PC6000 software to the C: drive and \PC6000 directory.

If you are using a two disk drive system, follow the instructions in Section 5.2. After installing the software, remove the disk from the drive and keep the original disk in a safe place.

If you have purchased Ecowatch for Windows, install the program from the Program Manager menu of your Windows system. Use this software 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. First close any Windows applications which are currently running. After inserting the Ecowatch floppy disk in your disk drive, access the File command from the top menu bar of the Program Manager window. Click on 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 a setup routine. After the setup is complete, you will be prompted to confirm that all applications have been closed and choose the hard drive location where Ecowatch will be installed. After answering these questions, the installation of Ecowatch will take place automatically. Simply follow the instructions on the screen after installation is complete.

2.5 PC6000 SOFTWARE SETUP

To start the software, make your current drive C:\PC6000 (or another directory where you have installed PC6000). Type **PC6000** and press Enter. The PC6000 software will load. The PC6000 menu bar will appear at the top of the computer screen:

```
 Sonde  File  Setup  Real-Time  Exit          PC6000
```
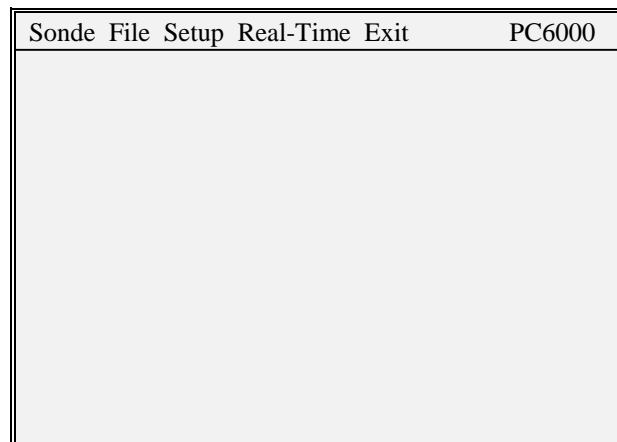
Use the arrow keys to move the cursor and highlight menu options. Press Enter to select a highlighted option. Press Esc to cancel an entry. A PC6000 Menu Flow Chart is shown below. This menu chart should help you to locate submenus more easily.

PC6000 MENU FLOW CHART 5/96

| Sonde | File | Setup | Real-Time | Exit |

6820

Filename

Return to DOS

Display Format

Readings Displayed

1. Run

Computer Connection

2. Calibrate

Computer Display

Parser

Site Name

3. System

More Setup

Instrument ID

4. Report

Data Capture

Filename

Autoconfigure

5. Sensor

Advanced Setup

X-axis Time

Global Switch

6. Advanced

Parameter/Plot

Data Files

View

Beep Notify

User-defined

Modify   System

Export

To start, highlight **Setup** then press Enter. Check the default setup values.

```
        ---DISPLAY -FORMATS---------COMPUTER-CONNECTIONS-------------
        Date format:           MDY   Comm port:            1
        Date separator:        /     Baud rate             9600
        Time separator:        :     Printer Port          1
        Radix mark:            .      Printer type          HP LaserJet laser

        -------MORE-SETUP-------------COMPUTER-DISPLAY---------------------
        Data capture setup...        Menu colors:          User-defined menu colors
        Advanced Setup...            Plot colors:          User-defined plot colors
                                     Graphics mode:        Automatic selection hi-res
```

Comm port:

Select this option to enter the number of the Comm port (1 or 2) to which the 6000UPG is connected.
Be sure to press Enter to confirm a new entry. If the default setting is correct there is no need to
change it.

Baud rate:

Select this option to check the baud rate. If the baud rate is not set to 9600, set it to 9600. To set
the baud rate, highlight it and press Enter. A list of possible baud rates will appear. Select 9600
from the list and press Enter.   NOTE: The Model 6000UPG default baud rate is 9600.

Printer port:

Select this option to specify the parallel port (LPT1, LPT2 or LPT3) to which your printer is
connected. If no printer is connected select LPT1. Press Enter after making your selection.

Printer type:

Select this option to select the type of printer connected to your computer system. From the list,
choose the selection that best describes your printer. If your printer is not on the list, refer to your
printer's instruction manual to determine what type of printer your printer emulates. Press Enter
after making your selection.

Menu colors:

Select this option to choose a color scheme for the PC6000 menus. As you move the cursor between color schemes, the screen changes to display your selection. Press Enter to confirm a selection.

Plot colors:

Select this option to choose a color scheme for the PC6000 plots. As you move the cursor between color schemes, the screen changes to display your selection. Press Enter to confirm a selection.

The other setup functions are described in Section 5.5, but usually are not necessary for a quick start into 6000UPG operations. Press Esc to exit the setup menu. The cursor will return to the menu bar.

ECOWATCH FOR WINDOWS

No setup is required for this program after installation. Use the "Help" command in the top menu bar to learn about the program.

2.6 SONDE SOFTWARE SETUP

There are two sets of software at work within the 6000UPG system. One is resident in your PC (called PC6000) and was provided on floppy disk with this instruction manual. The other software is resident in the sonde itself. When you select **Sonde** from the PC6000 top-line menu, the PC based software, begins direct communication with the sonde based software via standard VT100 terminal emulation.

Using the arrow keys, highlight and select **Sonde** from the top-line menu. The sonde Main menu will be displayed.

```
========================================
Main
----------------------------------------
1. Run                 5. System setup
2. Calibrate           6. Report setup
3. File                7. Sensor setup
4. Status              8. Diagnostics

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

NOTE: If no menu is displayed and a **#** appears at the top of the computer screen, follow the instructions on the screen and type **MENU** and press Enter. If a menu other than the Main menu is displayed, press Esc until the Main menu appears. If you cannot get to the Main menu, check to be sure the cable is properly connected, the batteries are properly installed and the Comm port and other software parameters are set up as described in Section 2.4, or see Section 8, Troubleshooting.

NOTE: The sonde software is menu driven. Select a function by typing its corresponding number. It is not necessary to press Enter after a number selection. Use the **0** or **Esc** key to return to a previous menu.

At the Main menu, select **5. System setup**. The System setup menu will be displayed.

```
========================================
System-setup
----------------------------------------
1. Date & time      4. Batteries
2. Radix            5. Instrument ID
3. Communication    6. Page Length

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

```
1. Date & time
```

Select this option to choose the date format and set the correct date and time. Select the format you desire; month/day/year, day/month/year or year/month/day. Next enter the date and time as prompted on the screen. Be sure to enter the hour, minute, <u>and</u> second values for the Time. The software will reject a Time entered with hour and minute entries only. Press Enter after each entry.

NOTE: For convenience any non-numeric key (such as **space**) in addition to **/** and **:** will separate the fields in the date and time entries.

```
4. Instrument ID
```

Select this option to identify your instrument with its serial number (located on the back of the sonde) or any other name or number you wish, up to 31 characters. Then press Enter**.**

Other options in the System setup menu are explained in detail in Section 4. Press Esc to backup to the Main menu.

```
========================================
Main
----------------------------------------
1. Run                  5. System setup
2. Calibrate            6. Report setup
3. File                 7. Sensor setup
4. Status               8. Diagnostics

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

You must now enable (or activate) the sensors which have been installed in your 6000UPG sonde.

Select **7. -Sensor setup**

```
========================================
Sensor-setup
----------------------------------------
1-(*) Temp              7-( ) ISE2 ORP
2-(*) Cond              8-( ) ISE2 NH4+
3-(*) DO                9-( ) ISE2 NO3-
4-( ) Depth             A-(*) Batt
5-(*) ISE1 pH           B-( ) Turb
6-( ) ISE1 mV           C-( ) TDG

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

Enter the corresponding number to enable the sensor(s) that are installed on the sonde. The activated selection is indicated by the asterisk.

You will see reference to TDG (total dissolved gas) in the Sensor setup menu. This is for possible future upgrade and is not currently available for your 6000UPG.

NOTE: The sensors that you have installed in your sonde may not include all that are shown "enabled" in the above screen. The display is only an example.

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

```
========================================
Main
----------------------------------------
1. Run                  5. System setup
2. Calibrate            6. Report setup
3. File                 7. Sensor setup
4. Status               8. Diagnostics

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

Even if all of your installed sensors are enabled, the measurements for that sensor may not appear on your display. In order for a specific parameter to be displayed:

1. The sensor must first be enabled (turned on).

2. That parameter must be activated in the Report section of the Main Menu.

Select **4-Report** from the Main sonde menu. The Report Setup menu will be displayed.

```
==========================================
Report-setup
------------------------------------------
1-(*) Date              G-(*) Sal ppt
2-(*) Time              H-(*) DO %
3-(*) Temp C            I-(*) DO mg/L
4-( ) Temp F            J-( ) Depth ft
5-( ) Temp K            K-( ) Depth m
6-(*) SpCond mS/cm      L-(*) pH
7-( ) SpCond uS/cm      M-( ) pH mV
8-( ) Cond mS/cm        N-( ) ORP mV
9-( ) Cond uS/cm        O-( ) NH4+ mg-N/L
A-( ) Resist MOhm*cm    P-( ) NH3 mg-N/L
B-( ) Resist KOhm*cm    Q-( ) NO3- mg-N/L
C-( ) Resist Ohm*cm     R-( ) Turb NTU
D-( ) TDS g/L           S-( ) TDG mm-Hg
E-( ) TDS kg/L          T-(*) Batt V
F-( ) TDS mg/L

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


The asterisk (*) following a given number or letter indicates that the parameter will appear on all outputs and reports. To turn a parameter on or off, type the number or letter of that parameter at the cursor. Continue this process until all parameters are either on or off as you wish.

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

See Section 4 for a more detailed description of the sonde menus. The sonde software is now set up and ready to calibrate and run. Proceed to Section 3.

3. BASIC OPERATION

In the previous Section, you learned how to install probes and set up the PC6000, Ecowatch for Windows, and 6000UPG sonde software. In this section, you will learn how to calibrate and run the Model 6000UPG and how to view your data on a computer display. If you choose to use your 6000UPG with a 610-series display/logger, refer to the operations manual for the 610 to obtain similar instructions to those provided below.

3.1 GETTING READY TO CALIBRATE

WARNING: Reagents used to calibrate and check this instrument may be hazardous to your health. Refer to Appendix A for health and safety information.

Before you begin the calibration procedures outlined below, you may find it helpful to follow some or all of these calibration tips.

1. You will need one or more containers to hold calibration standards. YSI provides a calibration cup, but a standard 800 mL beaker also works well.

2. If you use the 6000UPG Transport Cup for dissolved oxygen calibration, make certain to loosen the seal to allow pressure equilibration before DO calibration (water-saturated air calibration).

3. For maximum accuracy, the use of a small amount of previously-used calibration solutions to prerinse the sonde is suggested. You may wish to save old calibration standards for this purpose.

4. Fill a large bucket with ambient temperature water for rinsing 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. It is important to remove as much residual liquid as possible from the sonde after each rinse. Shake the sonde to remove excess rinse water from the inside of the guard. Then dry the outside of the sonde and probe guard. Drying the sonde and probes in this way reduces carry-over contamination of calibrator solutions and increases the accuracy of the calibration, particularly when using lower conductivity calibration standards.

6. It is not necessary 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.

3.2 CALIBRATION PROCEDURES

WARNING: Calibration reagents may be hazardous to your health. Refer to Appendix A for health and safety information.

A calibration cup is supplied with the Model 6000UPG. Because the calibration cup fits over the outside of the sonde probe guard, it is not recommended or necessary to remove the probe guard to calibrate the sensors. Follow the procedures below to calibrate the sensors. Temperature does not require calibration and is, therefore, not included in the **Calibrate** menu. ORP calibration is required only infrequently and is discussed in Section 4.2. For more detailed calibration procedures, which can be used to enhance the accuracy of some measurements, see Section 4.2.

The following sequence is provided as an **EXAMPLE** of the process the user will utilize to calibrate all sensors. *Although conductivity was chosen for this general example, more detailed instructions for the calibration of the conductivity sensor are found in the next section.*

From the sonde Main menu select **2. Calibrate.**

```
==========================================
Main
------------------------------------------
1. Run                 5. System setup
2. Calibrate           6. Report setup
3. File                7. Sensor setup
4. Status              8. Diagnostics

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

The Calibrate menu will be displayed.

```
==========================================
Calibrate
------------------------------------------
1. Conductivity        6. pH
2. DO%                 7. Ammonium
3. DO mg/L             8. Nitrate
4. Depth               9. Turbidity
5. ORP                 A. TDG

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

Selection of any of the parameters from the Calibrate menu listing will require the user to input a numerical value and then press Enter. For example, for calibration of the conductivity sensor, you should select **1**. **Conductivity** from the Calibrate menu and then **1. SpCond** from the Cond Calibration menu. The following display will be shown during the calibration sequence.

```
Enter SpCond in mS/cm (10):
```

The number in parentheses is the default value of this parameter and will be used in the calibration if *only* Enter is pressed without typing in another value. Remember that this entry should reflect the actual value of your solution and that entry of values other than the default may be necessary. Similar prompts will be displayed for calibration of all parameters.

```
=========================================================
   Date      Time    Temp  SpCond    Sal     DO     pH Batt
MM/DD/YY hh:mm:ss       C    mS/cm    ppt      %         V
---------------------------------------------------------
To calibrate, press <Enter> when the readings are stable.
05/22/96 09:53:43  27.73    5.05   2.72    54.9  8.73 12.2
```

After the calibration value is input (or the default accepted) and Enter is pressed, a real-time display similar to that shown above will appear on the screen. Note that all parameters which have been enabled will appear, not just the one being calibrated at the moment. You should carefully observe the stabilization of the readings of the parameter which is being calibrated and, when the readings are stable for approximately 30 seconds, press Enter to accept the calibration. The acceptance will be acknowledged and calibration of the chosen sensor is complete. Then, as instructed, Hit any key to return to the Calibrate menu.

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 8, Troubleshooting for more information on error messages. If error messages continue to be observed during calibration, contact YSI Customer Service (see Appendix C for contact information).

CAUTION: With rare exception, be certain to **immerse the __entire array of sensors__** in solution standards for calibration of all parameters. Most calibrations require readings not only from the sensor being calibrated but also from the temperature sensor. Temperature compensation is an important criterion in nearly all of the calibration procedures. In addition to temperature, the conductivity reading of the standard is required in several calibration routines and the reference electrode of the pH probe must be in the same solution as the nitrate and ammonium sensors for proper function.

Specific start-up calibration procedures for all sensors which commonly require calibration are provided in the following paragraphs of this section. Remember that these are basic protocols designed to get the user up and running with regard to the 6000UPG. The more-detailed discussion of sensor calibration found in Section 4.2 should be examined prior to use of the instrument in the field.

NOTE: If the particular sensor listed is not installed in your sonde, proceed to the next sensor until the calibration protocol is complete.

> **IMPORTANT MESSAGE!**
> **WHAT IF THERE IS NO RESPONSE TO A KEYSTROKE?**
> To save power, the 6000UPG will power down automatically if no interaction from the keyboard occurs for approximately 30 seconds. 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 6000UPG has been inactive for some time and nothing seems to happen, press the key again.

CONDUCTIVITY

NOTE: This procedure calibrates not only conductivity, but also specific conductance, salinity, and total dissolved solids.

Place approximately 500 mL of conductivity standard in a clean and dry calibration cup.

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 choose a 1 mS/cm conductivity standard.

❏ For brackish water choose a 10 mS/cm conductivity standard.

❏ For sea water choose a 50 mS/cm conductivity standard.

Caution: 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.

Without removing the probe guard, *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.

Allow at least one minute for temperature equilibration before proceeding.

From the Calibrate menu, select **1. Conductivity** to access the Conductivity calibration procedure and then **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 Hit any key to return to the **Calibrate** menu.

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

DISSOLVED OXYGEN

Place approximately 1/8 inch (3 mm) of water or a wet sponge in the bottom of the Calibration Cup or Transport Cup. Place the probe end of the sonde into the cup. Make certain that the DO and the temperature probes are not immersed in the water. Wait approximately 10 minutes for the air in the calibration cup to become water saturated and for the temperatures of the thermistor and the oxygen probe to equilibrate.

CAUTION: If the Transport Cup is used, make certain that the cup is vented to the atmosphere by loosening the vent screw.

From the **Calibrate** menu, select **2. DO%** to access the DO % calibration procedure.

Enter the current barometric pressure in mm of Hg. (Inches of Hg x 25.4 = mm Hg).

NOTE: *Remember that barometer readings which 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 computer will indicate that the calibration procedure is in progress.

```
Calibration will AUTOMATICALLY occur after warmup interval.
Warming Sensors: 27
```

After approximately 1 minute, the calibration will be complete. Press any key, as instructed, and the screen will display the percent saturation value which corresponds to your local barometric pressure input. For example, if your barometer reads 742 mm Hg, the screen will display 97.6 % (742/760) at this point.

After the calibration is complete, press any key to return to the **Calibrate** menu.

NOTE: Calibration of dissolved oxygen in the DO % procedure also results in calibration of the DO mg/L mode and vice versa.

Rinse the sonde in water and dry the sonde.

DEPTH

Following the DO calibration, leave the sonde in water-saturated air. Make certain that the sonde is not submerged in water for the depth calibration.

From the **Calibrate** menu, select **3. Depth** to access the depth calibration procedure. Input 0.00 or some known sensor offset in feet (the depth sensor is about 0.46 feet above the bottom of the probe compartment). 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 and zero the sensor with regard to current barometric pressure. Then, as instructed, Hit any key to return to the **Calibrate** menu.

pH 2-POINT

Place approximately 400 mL of pH 7 buffer in a clean 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 **6. pH** to access the pH calibration choices and then **2. 2-Point**. Press Enter and input the value of the buffer (or accept the default) 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. The display will indicate that the calibration is accepted.

After the pH 7 calibration is complete, Hit any key, as instructed on the screen, to continue.

Rinse the sonde in water and dry the sonde before proceeding to next step.

Place approximately 400 mL of a second pH buffer solution in a clean calibration cup. The second buffer might be pH 4 if the sample is expected to be acidic or pH 10 if the sample is expected to be basic. *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 value calibration is complete, Hit any key, as instructed on the screen, to return to the **Calibrate** menu.

Rinse the sonde in water and dry the sonde.

Thoroughly rinse and dry the calibration cups for future use.

AMMONIUM (NH$_4$$^+$) and NITRATE (NO$_3$$^-$) 3-POINT

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

NOTE: The calibration procedures for ammonium and nitrate 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).

NOTE: The following procedure requires <u>one</u> 500 mL portion of 100 mg/L calibrant and <u>two</u> 500 mL portions of 1 mg/L calibrant. The 100 mg/l solution and one of the 1 mg/L solutions should be at ambient temperature. The other 1 mg/L solution should be chilled to less than 10 C° prior to beginning the procedure.

CAUTION: Proper calibration of the ammonium and nitrate sensors requires that the pH, conductivity, and temperature probes also be immersed in the <u>same</u> solution as the sensor being calibrated. Therefore, do not remove the probe guard and attempt to immerse individual sensors in different vessels. For the ammonium and nitrate sensors to function at all, there must be solution contact between the pH and the ammonium or nitrate probe.

Place 500 mL of 100 mg/L standard into a clean calibration cup. *Carefully* immerse the probe end of the sonde into the solution.

Allow at least 1 minute for temperature equilibration before proceeding.

Select **7. Ammonium** or **8. Nitrate** to access the appropriate calibration choices. Then select **3. 3-Point**. Press Enter and input the concentration value of the standard as requested or accept the default. 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+ or NO3- . When they show no significant change for approximately 30 seconds, press Enter.

After the second value calibration is complete, as instructed, Hit any key to continue.

Rinse the sonde in water and dry the sonde prior to the next step.

Place 500 mL of the ambient temperature 1 mg/L standard solution in a clean 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 concentration value of the standard as requested or accept the default. 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+ or NO3- and when they have show no significant change for approximately 30 seconds, press Enter.

After the second value calibration is complete, as instructed, Hit any key to continue.

Place 500 mL of the chilled 1 mg/L standard solution in a clean 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 or accept the default. 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+ or NO3- and when they show no significant change for approximately 30 seconds, press Enter.

After the third value calibration is complete, Hit any key to return to the **Calibrate** menu.

Thoroughly rinse and dry the calibration cups for future use.

CALIBRATION TIP: AVOIDING DRIFT DURING CALIBRATION OF THE NH4+ AND NO3- PROBES AFTER pH CALIBRATION. Exposure to the high ionic content of pH buffers can cause a significant, but temporary, drift in either the ammonium or the nitrate probe. Therefore, when calibrating the nitrate or ammonium sensor, we recommend 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 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 or ammonium immediately after pH calibration.

TURBIDITY   2-POINT

WARNING: THE TURBIDITY SENSOR CAN ONLY BE USED AT DEPTHS OF <u>LESS THAN 200 FEET (61 METERS)</u>. USE OF THE PROBE AT GREATER DEPTHS IS LIKELY TO PERMANENTLY DAMAGE THE SENSOR.

Select **9. 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 immerse the sonde in approximately 300 mL of 0 NTU standard (clear deionized, distilled, or tap water), as instructed, and press Enter. Input the value 0.00 NTU at the prompt, and press Enter. After calibration of the mechanical wiper speed, the screen will display real-time readings which will allow you to determine when the turbidity values have stabilized. If the readings appear unusually high or low or are unstable, there are probably bubbles on the optical surface. Activate the mechanical wiper by pressing the "3" key to remove the bubbles. After stable readings are observed for approximately 40 seconds, press Enter to "confirm" the first calibration and then, as instructed, Hit any key to continue.

Dry the sonde and probes carefully and then place the sonde in approximately 300 mL of the second turbidity standard (100 NTU is suggested). Input the correct turbidity value in NTU, press Enter, and view the stabilization of the values on the screen in real-time. As described above, if the readings appear unusually high or low or are unstable, activate the wiper to remove bubbles and be sure to wait at least 40 seconds before confirming the calibration. After the readings have stabilized, press Enter to "confirm" the calibration and then, as instructed, Hit any key to return to the **Calibrate** menu.

Thoroughly rinse and dry the calibration cups for future use.

CAUTION: If the turbidity system has been set up as outlined in Section 2 of the manual, signal averaging will be taking place during calibration and the response time of the sensor will be slightly slower than that of the other sensors. This effect makes it critical to observe at least 40 seconds of stable readings prior to "confirming" the calibration. Be particularly careful to take your time during the calibration of the turbidity system.

3.3 DISCRETE SAMPLING

To start taking readings with your 6000UPG, use the **Discrete sampling** mode to turn on or turn off the continuous sampling function. Data will be displayed to the screen and optionally saved to internal flash disk memory or to a computer or logger display.

Select **1. Run** from the sonde Main menu. The Run menu will be displayed.

```
==========================================
Run
------------------------------------------
1. Discrete sample
2. Conditional Sample
3. Unattended sample

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

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

```
==========================================
Discrete-sample
------------------------------------------
1. Start sample
2. Site description
3. Sample interval
4. Close file
5. Set Auto-stop timer

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

Select the different functions in this menu to become familiar with the Discrete sampling mode. Remember to use Esc or **0** to cancel functions or to back up to the previous display.

```
1.  Start discrete sample
```

Select this option to start discrete sampling. After the initial sampling time interval has passed, data will be displayed on the screen.

A *single line of data* can be logged to flash disk memory by pressing **1.** (screen prompt reads '1-LOG last sample').

A *set of data* can be logged to flash disk by pressing **2**. (screen prompt reads '2-LOG ON/OFF'). A message will be displayed that LOG is on, turn it off by selecting **2**.

If installed, the turbidity probe face can be cleaned by pressing **3** (screen prompt reads '3-Clean optics').

Select Esc to exit discrete sampling.

```
2.  Site description
```

Select this option to name the site of the sample if you intend to log data while discrete sampling. Up to 31 characters can be entered, but only the first 8 will be used in naming the file after transfer to a computer for analysis. The site description you enter will be displayed with the file name to help you identify the file later.

```
3.  Sample interval
```

Select this option to set the interval which will pass between samples. Enter the desired interval in seconds. The default sample interval is 4 seconds.

```
4.  Close file
```

Select this option to close any discrete sample file. A file is opened automatically whenever data is logged to flash disk memory. When you exit discrete sample mode, you can close the file using this function or you can leave it open and log to it later.

```
5.  Set Auto-stop timer
```

Select this option to set up a timer to automatically turn off discrete sampling. If you begin a discrete sample and forget to turn it off later, battery life will be greatly reduced. For this reason, the **Auto-stop timer** can be set up to automatically turn off any active discrete sample if it has been left on for a specified period of time. Simply type in what you feel is an appropriate amount of minutes, and the program will turn off discrete sampling after that many minutes have passed. Setting the timer to **0** disables the Auto-stop timer and discrete sampling will never be stopped by the Auto-stop timer.

After you have become familiar with these selections, press 1-Start Discrete Sample and observe the data appear on your computer screen. The general format of the display will be as follows, although the detail will depend on which parameters which you have activated.

```
=========================================================================
    Date      Time    Temp  SpCond   Sal     DO     DO    pH   Turb Batt
MM/DD/YY hh:mm:ss       C   uS/cm    ppt      %    mg/L             NTU    V
-------------------------------------------------------------------------
*** 1-LOG last sample   2-LOG ON/OFF, 3-Clean optics ***
06/17/96 09:20:44  27.73    995   0.49   50.9   4.42  7.42    0.3 12.2
06/17/96 09:20:48  27.73    995   0.49   48.5   4.21  7.42    0.4 12.2
06/17/96 09:20:52  27.73    995   0.49   47.2   4.09  7.42    0.4 12.2
06/17/96 09:20:56  27.73    995   0.49   46.3   4.02  7.42    0.4 12.3
06/17/96 09:21:00  27.73    995   0.49   45.7   3.96  7.42    0.4 12.2
06/17/96 09:21:04  27.73    995   0.49   45.2   3.92  7.42    0.4 12.2
06/17/96 09:21:08  27.73    995   0.49   44.8   3.81  7.42    0.4 12.2
06/17/96 09:21:12  27.73    995   0.49   44.9   3.87  7.42    0.4 12.2
```

To stop the Discrete Sample mode, press Esc or '0' until the sonde Main menu is displayed.

3.4 UNATTENDED SAMPLING

The Unattended Sampling Mode is designed to log readings of all user-defined parameters at intervals you specify. The 6000UPG can be deployed for weeks at a time using this feature. Throughout the deployment, data is stored to internal flash disk memory. This data can be uploaded to the PC6000 software upon completion of the study, or at anytime during the study without stopping the logging.

Select **1. Run** from the sonde Main menu. The Run menu will be displayed.

```
=======================================
Run
---------------------------------------
1. Discrete sample
2. Conditional Sample
3. Unattended sample

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

Select **3. Unattended sample** from the Run menu. The current time and date, all active sensors, battery voltage, and free flash disk space will be displayed.

NOTE: If the current time and date are not correct, your unattended sampling study will not begin or end when you desire. To correct the time and date see Section 2.5.

You will be asked to enter the following information concerning the unattended sampling study you wish to set up.

```
Enter starting date (XX/XX/XX):
Enter starting time (XX:XX:XX):
Enter duration in days (XX.XXX):
Enter interval in minutes (XX):
Enter site description (UNTITLE):
```

To gain experience, set up an unattended sampling study with the following responses to the above questions:

Enter starting date: *today's date*
Enter starting time: *current time*
Enter duration in days: *1*
Enter interval in minutes: *2*
Enter site description: *First-test*

NOTE: The time entry must include not only hours and minutes, but also seconds. For example, if you want to start a study at 8 AM, you must enter 8:00:00, and not just 8:00. The software will prompt you with a beep if the time is entered incompletely.

You will be asked if all start-up information is correct. Check the information *carefully* and, if you want to change something, press "N". If all information is correct, press "Y". The following message will be displayed briefly:

```
************************************
* INSTRUMENT IS IN UNATTENDED MODE  *
************************************
```

To continue the "First-test" study you have just started, disconnect the cable from the sonde and screw on the waterproof connector cap. The unit is now ready for deployment. If the calibration cup is installed, remove it and place the 6000UPG in at least 6 inches of water. Leave it there for an hour. Proceed to the next section.

CAUTION: If you intend to transfer data logged in an Unattended study to a 610-DM at a later time, it is important back completely out of the sonde menu structure before disconnecting the cable. To do this, press the Esc key until you reach the Main menu. Then press Esc once more and when the question "Exit menu? (Y/N)" appears, enter "Y": The message "OK" followed by the # sign will appear. At this point, disconnect the cable from the unit and allow data to be logged to memory. Depending on the version of software in your 610, if you do not back out of the menu structure, no communication will occur when using a 610 at a later time.

3.5 RETRIEVING DATA FROM THE 6000UPG

Attach the PC cable to the 6000UPG. Connect the other end of the cable to the serial port of your computer.

Run the PC6000 software and select **Sonde** from the top-line menu using the arrow keys.

```
┌──────────────────────────────────────────┐
│ Sonde File Setup Real-Time Exit    PC6000 │
├──────────────────────────────────────────┤
│                                          │
│                                          │
│                                          │
│                                          │
│                                          │
│                                          │
│                                          │
│                                          │
│                                          │
│                                          │
└──────────────────────────────────────────┘
```
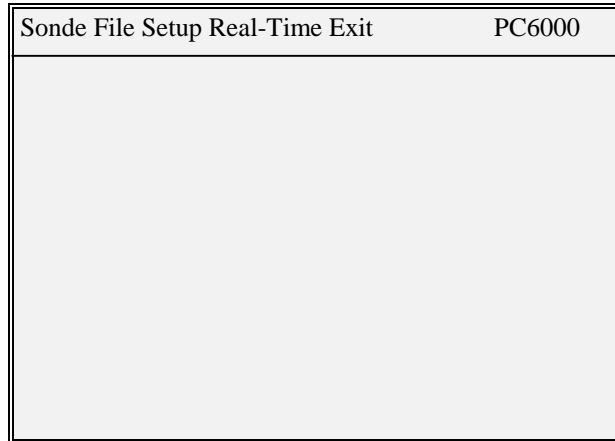
NOTE: If communication with the sonde fails, first check all cable connections and the comm port information under **Setup** of the PC6000 top-line menu. If all cable connectors are properly attached and the comm port setting is correct, it is likely that the sonde batteries have been depleted. To replace the sonde batteries see Section 2.2.

From the sonde Main menu select **1. Run**.

NOTE: If the instrument is busy taking a sample it will display the following message:

** Instrument is busy. Please wait. **

Wait until the Run menu appears and select **3. Unattended Sample**. The screen will display a prompt asking if you wish to cancel the unattended sampling study.

```
┌──────────────────────────────────────────┐
│ ** INSTRUMENT IS IN UNATTENDED MODE **    │
│                                          │
│                                          │
│ Start date and time  : 05/31/96 11:04:08 │
│ Duration (days)       : 30.000           │
│ Interval (minutes)    : 2                │
│ Site description      : First-test       │
│                                          │
│                                          │
│ UNATTENDED mode active. Cancel (Y/N)?    │
│                                          │
│                                          │
└──────────────────────────────────────────┘
```
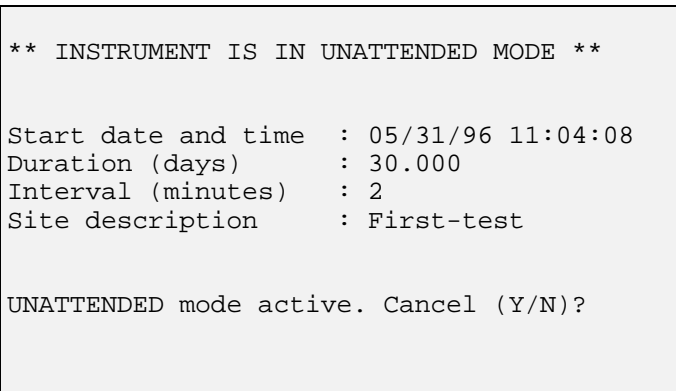
NOTE: Data can also be uploaded while an unattended sampling study is in progress.

NOTE: If unattended sampling has already stopped automatically because the duration you entered earlier has expired, press Esc twice to return to the Main menu.

Press "Y" and Enter to stop the Unattended study.

Return to the sonde **Main** menu using the Esc key. Select **3. File** to display the File menu.

```
========================================
File
----------------------------------------
1. Directory          5. Quick view file
2. Upload             6. Delete file
3. Quick Upload       7. Format FlashDisk
4. View file          8. Test FlashDisk

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

Select **3. Quick upload** to display the Quick-Upload menu.

```
========================================
File Quick Upload
----------------------------------------
1. PC6000
2. Comma & ' ' Delimited
3. ASCII Text

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

Select **1. PC6000** to upload to the PC6000 software. A secondary menu will appear to show the progress of the upload.

NOTE: Comma & " " Delimited and ASCII Text formats are available for uploading data to a spreadsheet or database program. See Section 4.3 for more details.

When the upload is complete, press Esc until the sonde Main menu returns. Press F10 to exit the sonde menu and return to the PC6000 top-line menu.

3.6 ANALYZING DATA WITH PC6000

Select **File** from the top-line menu.

| Sonde | File | Setup Real-Time   Exit   YSI PC6000 |
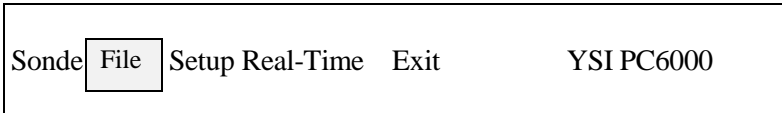
A box will appear on the screen asking you to enter a filename.
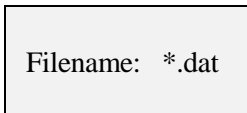
Filename: *.dat

You may type a file name or press Enter for a directory. If the directory contains more than one data file, a list of files will be displayed. Use the arrow keys to highlight and the Enter key to select the file of choice.

NOTE: If only one data file is resident in the directory, it will be automatically loaded.

After the selected file has been retrieved, the following menu will be displayed:

MODIFY	VIEW	SYSTEM
Parameters...	Header	Print Report
Control Info...	Report	Print Plot
Scaling Info...	Plot	Definitions
	Statistics	Export

Any changes made from this menu will affect only the current file. To change default values for all files, see Section 5.5.
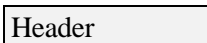
Header

Select this option to view general information about the file. Information displayed on the header screen includes the file name, site description, a list of active sensors, and other details about this file. Press Esc to return to the File menu.

Report

Select this option to view a time-stamped report of the data collected during the study. Press Esc to return to the File menu.

Plot

Select this option to view a plot of the data collected during the study.

All plots and reports can be customized to your specific requirements. See Section 5.4 for details.

Press Esc until the top-line menu of the PC6000 program appears.

You have now completed Basic Operation, which includes both basic calibration procedures and basic steps in taking a measurement and capturing data. There is much more information in further sections of the manual. Once you are comfortable with the basic operation, take time to explore additional parts of the manual to learn more about this sophisticated environmental monitoring system.

4. SONDE MENU

The Model 6000UPG functions 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 key to backup to the previous menu. To exit menus and return to the sonde command line (# sign), press 0 or Esc until the question **Exit menu (Y/N)?** appears.   Then type **Y** and press Enter. Type 'menu' and Enter from command line to return to a display of the Main sonde menu.

IMPORTANT MESSAGE!
WHAT IF THERE IS NO RESPONSE TO A KEYSTROKE?
To save power, the 6000UPG will power down automatically if no interaction from the keyboard occurs for approximately 30 seconds.   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 6000UPG has been inactive for some time and nothing seems to happen, press the key again.

To gain experience with the sonde menus, select **Sonde** from the PC6000 menu bar and press Enter. The sonde Main Menu will be displayed.

```
========================================
Main
----------------------------------------
1. Run                 5. System setup
2. Calibrate           6. Report setup
3. File                7. Sensor setup
4. Status              8. Diagnostics

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

4.1 RUN

Select **1. Run** from the Main menu to choose a mode of operation, to begin taking readings or to set up many of the parameters required for a study. There are three options on the Run menu (described below).

```
========================================
Run
----------------------------------------
1. Discrete sample
2. Conditional Sample
3. Unattended sample

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

4.1.1. DISCRETE SAMPLE

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

```
========================================
Discrete-sample
----------------------------------------
1. Start sample
2. Site description
3. Sample interval
4. Close file
5. Set Auto-stop timer

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

```
1.   Start discrete sample
```

Select this option to start discrete sampling. After the initial sampling time interval has passed, data will be displayed on the screen. The following prompt will appear just below the screen header:

*** 1-LOG last sample   2-LOG ON/OFF, 3-Clean optics ***

A single line of data can be logged to flash disk memory by pressing **1**. A set of data can be logged to flash disk by pressing **2**. If you select **2** the following message will be displayed:

*** LOG is ON, hit 2 to turn it OFF, 3-Clean optics ***

If your unit has a turbidity probe installed, the optical surface will be cleaned by the wiper if you select **3.**

NOTE: The **3-Clean optics** portion of the prompt will appear *only* if a turbidity probe is installed in your unit and the sensor is enabled.

Select Esc or press 0 to exit discrete sampling.

```
2.   Site description
```

Select this option to name the site of the sample if you intend to log data while discrete sampling. Up to 31 characters can be entered. However, remember that only the first 8 characters will be used in naming the file after transfer to a computer or data logger. The site description you enter will be displayed as the file name to help you identify the file later. If a discrete sampling file is open, a new site description will not take effect until the existing file is closed.

```
3.   Sample interval
```

Select this option to set up the number of seconds between samples. Enter the desired interval in seconds. The default sample interval is 4 seconds.

```
4.   Close file
```

Select this option to close any discrete sample file. A file is opened automatically whenever data is logged to flash disk memory. When you exit discrete sample mode, you can close the file using this function or you can leave it open and log to it later. In order to open a new discrete sample file, the existing open discrete sample file must first be closed.

```
5.   Set Auto-stop timer
```

Select this option to set the Auto-stop timer to turn off a discrete sample after a selected amount of time has passed. If you begin a discrete sample and forget to turn it off, battery life will be greatly reduced. To set the timer, select and enter an appropriate amount of minutes for your application, and the program will turn off discrete sampling after that many minutes have passed. Setting the timer to 0 disables the function and discrete sampling will never be stopped by the Auto stop timer.

4.1.2. CONDITIONAL SAMPLE

Select **2. Conditional sample** from the Run menu and press Enter. The Run Conditional-sample menu will be displayed.

```
========================================
Conditional-sample
----------------------------------------
1. Start sample      4. Close file
2. Site description  5. Define condition
3. Sample interval   6. External switch

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

The conditional sampling feature of the 6000UPG sets up the sonde to sample only when a pre-specified condition exists.

```
1.  Start conditional sample
```

Select this option to begin conditional sampling. Conditional sample is much like Discrete Sample with regard to setting site description, sample interval, etc. The difference is that the specific condition which you wish to act as a switch for the 6000UPG must first be defined in **5. Define condition**. If an Unattended sample is active, a conditional sample can not be set up until the unattended sample has been stopped. When conditional sampling is activated, the condition will appear under the parameter header at the top of the screen and data will appear and be logged if the condition is met.

```
2.  Site Description
```

Select this option to name the site of the sample. The site description can have up to 31 characters, but only 8 characters will be used when naming the file after transfer to a computer or data logger. The site description you enter will be displayed as the file name to help you identify the file later.

```
3.  Sample interval
```

Select this option to set up the number of seconds between samples. While the user defined condition exists, the 6000UPG will record data to flash disk memory at the interval you specify.

```
4.  Close File
```

Select this option to close a conditional sample file. As soon as the first conditional sample data has been logged to flash disk memory, the 6000UPG will automatically open a file with the site description you have entered. This file will remain open until it is closed using **4. Close File**. After you stop a conditional sample, you can leave the file open and log to the same file at a later time. If you choose to log to an open file at a later time, you can continue to use the condition you defined earlier or choose a new condition. In addition, you can also log to this file in a Discrete Sample mode.

```
5.  Define Condition
```

Select this option to set up any parameter as a conditional switch. You define a high or low level threshold for the parameter you have selected which must exist before the 6000UPG will log data to flash disk memory. If, and only if, the condition of the sample reaches the level you have defined, will the 6000UPG begin logging data to flash disk memory.

After **5 Define Condition** is pressed, the following menu will be displayed.

```
=========================================
Set-Condition
-----------------------------------------
1-(*) Temp C            F-( ) DO %
2-( ) Temp F            G-( ) DO mg/L
3-( ) Temp K            H-( ) Depth ft
4-( ) SpCond mS/cm      I-( ) Depth m
5-( ) SpCond uS/cm      J-( ) pH
6-( ) Cond mS/cm        K-( ) pH mV
7-( ) Cond uS/cm        L-( ) ORP mV
8-( ) Resist MOhm*cm    M-( ) NH4+ mg-N/L
9-( ) Resist KOhm*cm    N-( ) NH3 mg-N/L
A-( ) Resist Ohm*cm     O-( ) NO3- mg-N/L
B-( ) TDS g/L           P-( ) Turb NTU
C-( ) TDS kg/L          Q-( ) TDG mm-Hg
D-( ) TDS mg/L          R-( ) Batt V
E-( ) Sal ppt

Condition: Temp C > 18.000

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

In this example, the instrument is set up to log samples only if the temperature of the sample is above 18°C.

To alter the switch so that data is logged when the specific conductance is greater than 100 uS/cm and temperature is greater than 18°C, first press **5** for SpCond mS/cm.

The prompt **0-lower or 1-higher than (1)** will appear on the screen under the menu.

First type **1 (higher than)** and press Enter.

The screen prompt will ask for the condition: **Threshold (0.000**):

Enter your new condition in uS/cm (100) and press Enter.

The screen will now display the altered menu which shows the new condition and data will be logged only when the temperature is greater than 18 °C AND the specific conductance is greater than 100 uS/cm.

```
========================================
Set-Condition
----------------------------------------
1-(*) Temp C              F-( ) DO %
2-( ) Temp F              G-( ) DO mg/L
3-( ) Temp K              H-( ) Depth ft
4-( ) SpCond mS/cm        I-( ) Depth m
5-(*) SpCond uS/cm        J-( ) pH
6-( ) Cond mS/cm          K-( ) pH mV
7-( ) Cond uS/cm          L-( ) ORP mV
8-( ) Resist MOhm*cm      M-( ) NH4+ mg-N/L
9-( ) Resist KOhm*cm      N-( ) NH3 mg-N/L
A-( ) Resist Ohm*cm       O-( ) NO3- mg-N/L
B-( ) TDS g/L             P-( ) Turb NTU
C-( ) TDS kg/L            Q-( ) TDG mm-Hg
D-( ) TDS mg/L            R-( ) Batt V
E-( ) Sal ppt

Condition: Temp C > 18.000
Condition: SpCond uS/cm > 100.000

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

NOTE: Before a condition can be applied to a parameter, the parameter must be selected for viewing in the Report Setup menu. (See section 4.6). However, you can set up conditions for any and all of these selected parameters -- many more than the two shown in the above example.

After the condition is defined correctly, press Esc to return to the Conditional sample menu.

---

3.   External switch

6000UPG instruments designated UPG3 on the serial label have the capability of supplying a logic level output to an external device through the YSI 6096 MS-8 to flying lead adapter. When the condition is met and the external switch is enabled, the 6000UPG will send a +5V signal to the external device. When the condition is not longer satisfied, the 6000UPG will output a 0V signal. If the external switch is not enabled, this output is put into a high impedance state and not driven.

4.1.3. UNATTENDED SAMPLE

Select **3. Unattended sample** from the Run menu. The following menu will be displayed.

```
=======================================
Unattended-sample
---------------------------------------
EMS6000 version 3.00 (6/07/96).
Current date and time: 06/04/96 07:29:53
Sensors: Temp,Cond,DO,ISE1 mV,Batt,Turb
Hardware revision: UPG3
Battery type: Alkaline
Battery voltage (Volts)       : 12.3
Free Flash disk space (KBytes): 100
```

NOTE: If the current time and date are not correct, your unattended sampling study will not begin or end when you desire. To correct the time and date, see Section 2.5.

You will be asked to enter the following information concerning the unattended sampling study you wish to set up.

```
Enter Starting date (xx/xx/xx):
Enter Starting time (xx:xx:xx):
Enter duration in days (xx.xxx):
Enter interval in minutes (x):
Enter site description ():
```

Be sure to enter hours, minutes <u>and </u>seconds for time entry. If you enter only hours and minutes, the sonde will not accept the entry.

After entering the information, the program will re-display what you entered in the following format.

```
==================================
Run Unattended-sample Setup
----------------------------------
EMS6000 version 3.00 (5/24/96).
Current date and time: 06/04/96 07:37:58
Sensors: Temp,Cond,DO,ISE1 mV,Batt,Turb
Hardware revision: UPG3
Battery type: Alkaline
Battery voltage (Volts)     : 12.2
Free Flash disk space (KBytes): 100

Start date and time  : 06/04/96 07:29:53
Duration (days)      : 30.000
Interval (minutes)   : 15
Site description     : Unattended Study

Estimated C-cell life at 25C (days): 46.9
Estimated Flash  disk  full  (days): 56.1
First sample will begin in
     6 minutes 55 seconds

Is all setup correct (Y/N)?
```

The program will automatically calculate how long batteries will last, and how long it will take for flash disk memory to be filled. This information is displayed on the screen for your consideration. If either the battery life, or the flash disk capacity will be exceeded sooner than the **Duration** you entered, you may want to make some changes. You might want to upload all existing data from flash disk to your computer and then format the flash disk to free up memory. You may want to change batteries if the current set is not completely new. You may want to change the sampling interval to extend both battery and flash disk capacity.

If you make a mistake on your entry with regard to any of the input parameters, press **N** at the **Is all setup correct (Y/N)?** prompt. The unattended setup sequence will reappear to allow you to make corrections..

After all information is correct, press **Y** at the prompt and the following message will be displayed briefly:

```
***************************************
** INSTRUMENT IS IN  UNATTENDED MODE **
***************************************
```

The Unattended sample study will shut off automatically when the duration you specified has expired. If you want to shut off the study sooner, simply select **3. Unattended sample** from the Run menu. If the 6000UPG is taking a reading at that moment, you will see the following message:

Instrument is busy. Please wait.

This message will disappear when the unattended sampling is over and you will be able to interact with the sonde via the menu. You will be then be given the option to discontinue the unattended sample as shown below.

```
** INSTRUMENT IS IN UNATTENDED MODE **


Start date and time  : 05/31/96 11:04:08
Duration (days)      : 30.000
Interval (minutes)   : 2
Site description     : First-test


UNATTENDED mode active. Cancel (Y/N)?
```

To stop the Unattended study, enter "Y" and press Enter.

4.2 CALIBRATE

All of the 6000UPG sensors (except temperature) require periodic calibration to assure high performance. Select **2. Calibrate** from the sonde Main menu, the Calibrate menu will be displayed.

```
=========================================
Calibrate
-----------------------------------------
1. Conductivity        6. pH
2. DO%                 7. Ammonium
3. DO mg/L             8. Nitrate
4. Depth               9. Turbidity
5. ORP                 A. TDG

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

```
1.   Conductivity
```

Select this option to calibrate the conductivity probe and a second menu will offer you the options of calibrating in Specific Conductance, Salinity, or Conductivity. 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.

```
2.  DO %
```

Select this option to calibrate the oxygen probe in 100% water saturated air. Be certain that the sensor has been thermally equilibrated in water-saturated air, and that the sensor shows stable readings in Discrete Sample mode prior to beginning the calibration routine, particularly after a membrane change. See section 3.2 for more details. Relieve pressure in the calibration cup, if necessary. **Remember that the 6000UPG transport cup is designed to be air tight and the vent screw must be loosened if the vessel is used as a calibration chamber.**

Then enter the local barometric pressure in mm Hg, press Enter, and the dissolved oxygen sensor will calibrate. Approximately 1 minute is required for DO % calibration.

```
3.  DO mg/L
```

Select this option to calibrate the oxygen probe to a water sample which contains a known concentration of dissolved oxygen. For this calibration procedure, the sensor should be immersed in water containing a known concentration (mg/L) of dissolved oxygen, usually determined by performing a Winkler titration. After thermal equilibration, enter this value, press Enter, and the 1 minute calibration procedure will begin.

```
4.  Depth
```

Select this option to zero the depth sensor. The depth sensor is factory calibrated. It is, however, necessary to zero the sensor with regard to the local barometric pressure. The zeroing procedure should be carried out with the sonde suspended in air. Do not attempt to zero the depth probe when the sonde is immersed. After the depth option is selected, enter 0.00 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 any key 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 bottom of the sonde bulkhead. This bulkhead is approximately 0.46 ft above the bottom of the sonde guard. Thus, in order for the observed depth to better reflect the distance between the water surface and the probe array, enter 0.46 at the screen prompt instead of 0.00.

```
5.  ORP
```

Select this option to calibrate the ORP sensor. Immerse the ORP probe in a solution with a known ORP value (we recommend Zobell solution) and press Enter. You will be prompted to enter the ORP value of the solution as found on the bottle. Press Enter, and monitor the stabilization of the

ORP readings. After no changes occur for approximately 30 seconds, press Enter to confirm the calibration. Then, as instructed, press any key to return to the Calibrate menu.

```
6.   pH
```

On selecting this option, you will by 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 you are using. Press Enter again, and the screen will display real-time readings which will allow you to determine when the pH readings have stabilized. Pressing Enter will confirm the calibration. Then, as instructed, press any key to return to the Calibrate menu.

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 *one additional* 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. Be certain that the buffer and sensor are thermally equilibrated prior to entering pH values.

To begin the calibration, immerse the sonde in pH 7 buffer, as instructed, and press Enter. The screen will display real-time readings which will allow you to determine when the pH readings have 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 any key 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 should be used to assure 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. Be certain that the buffer and sensor are thermally equilibrated prior to proceeding with the calibration.

```
7.   Ammonium
```

On selecting this option, you will by 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 as close as possible to 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 two calibration solutions, one 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°.

```
8.   Nitrate
```

On selecting this option, you will be given the choice of 1-point, 2-point, or 3-point calibrations for your nitrate (NO_3^-) sensor. *The procedures for calibration of the nitrate sensor are identical to those in 7 above for the ammonium sensor*, except that the calibrant values are in mg/L of NO_3-N instead of NH_4-N.

```
9.   Turbidity
```

On selecting this option, you will be given the choice of 1-point, 2-point, or 3-point calibrations for your turbidity sensor.

The **1-point** option is used only to zero the turbidity probe. 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 which 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. 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. One of the standards must be clear water (0 NTU) and the other should be in the range of known turbibity 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. If the water to be evaluated is known to be very cloudy, an appropriate choice of standards might be 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 which 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 by 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 which 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 be certain that the standard and sensor are thermally equilibrated prior to proceeding with the calibration. Remember that all multipoint *turbidity calibrations must be done in order from 0 NTU and up. In this example, do 0 NTU, then 10 NTU, and finally 100 NTU.*

4.3 FILE

In general, selections from the **File** menu allow the user to access data which has been stored in the sonde flash disk memory. Select **3. File** from the sonde Main menu and the File menu will be displayed:

```
========================================
File
----------------------------------------
1. Directory         5. Quick view file
2. Upload            6. Delete file
3. Quick Upload      7. Format FlashDisk
4. View file         8. Test FlashDisk

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

```
1. Directory.
```

Select this option to view on the computer screen a listing of all files currently stored in flash disk memory.

```
2.  Upload.
```

Select this option to view a list of files stored in flash disk memory. You can select any file or portion of a file to transfer from flash disk memory to PC6000 or other software programs. Three formats are possible for the transfer.

```
========================================
File Upload
----------------------------------------
1. PC6000
2. Comma & ' ' Delimited
3. ASCII Text

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

```
1.  PC6000.
```

Select this option to upload a file from the sonde's flash disk memory to the PC6000 software. Data is uploaded in a form compatible with the PC6000 software which is supplied with the system.

```
2.   Comma & " " Delimited
```

Select this option to upload data from the sonde's flash disk memory to a software program other than PC6000. Data is uploaded in comma & " " delimited format directly to the specified disk drive of your computer. This data format is ideal for importing into most spreadsheet software and allows you to 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 section 4.5 for details.

```
3.   ASCII Text
```

Select this option to upload data from the sonde's flash disk memory to a software program other than PC6000. Data is uploaded in standard ASCII Text format directly to the specified disk drive of your computer.

After you have selected one of these three upload formats, a list of files currently stored on flash disk memory will be displayed. At the bottom of the list, the following prompt will be displayed.

```
Enter file number to UPLOAD (1):
```

Input the number of the file which you wish to upload to your computer software and press Enter. The following prompt questions will appear.

```
Enter starting date (XX/XX/XX):
Enter starting time (XX:XX:XX):
Enter stopping date (XX/XX/XX):
Enter stopping time (XX:XX:XX):
```

If you wish to upload the entire file, press Enter at each prompt. The complete file will begin uploading automatically and a box will appear on the screen showing the progress of the upload.

If you wish to upload only a portion of the file, enter the start and stop dates and times which correctly define the portion of the file you wish to upload. Press Enter after each date or time. The upload will begin automatically when all dates and times have been entered. A box will appear on the screen showing the progress of the upload.

```
3.   Quick upload
```

Select this option to cause the most recent flash disk file to be uploaded in its entirety to the specified disk drive of your computer. The transfer of data can be carried out in the same three formats applicable to the Upload option described above.

```
4.  View file.
```

Select this option to examine the data in any file currently stored in flash disk memory. The following prompt will appear.

```
Enter file number to VIEW (1):
```

Input the number of the file you wish to view and press Enter. Next, you are asked for the start date and time and the stop date and time. Input any segment of time which falls between the begin and end dates and times on the file list displayed on the screen.

Selection of this option allows you to view an entire data file, or a portion of a file, on the computer screen.

NOTE: If the dates or times you input do not fall within the begin and end times of the file you have selected, no data will be displayed.

NOTE: The Pause/Break key can be used to stop the scrolling at any time during the scrolling process. The Enter key is used to resume scrolling. Pressing the Esc key during the scrolling process will give the user the option to abort the view.

```
5.  Quick view file.
```

Select this option to view, on the computer screen, the last page of data from the last data file in flash disk memory. The feature is particularly useful in quickly reviewing recently acquired data at field sites so that system performance can be assessed

```
6.  Delete file.
```

Select this option to remove any designated file from the list of files in the directory.

NOTE: This procedure only clears the directory listing and does NOT provide extra storage capacity.

```
7.  Format Flash Disk.
```

Select this option to *IRREVERSIBLY* remove all files from the flash disk. It is critical not to use the **Format Flash Disk** command until all relevant data has been transferred to your computer via an upload option (see previous upload information in this section). You will need to format the flask disk periodically in order to clear space for new files.

NOTE: *Use caution when choosing the Format Flash Disk option, since all data will be lost once the procedure has begun. However, calibration and setup information will not be erased.*

```
8.  Test Flash Disk
```

Select this option to verify that the entire flash disk memory system is working properly. As with the Format Flash Disk command this option also *IRREVERSIBLY* removes all files from flash disk memory. After this option is selected, the flash disk will be formatted, written to, and confirmed. During each process, prompts will appear on the screen to inform you of the progress of the procedure.

To find out how much flash disk space is still available, select **STATUS** from the sonde Main menu.

NOTE: *Use caution when choosing the Test Flash Disk option, since all data will be lost once the procedure has begun. However, calibration and setup information will not be erased.*

4.4 STATUS

Select **4. Status** from the sonde Main menu to obtain general information about the sonde and its setup. The battery voltage and available flash disk memory are also displayed. If an unattended sample is in progress, all the preset unattended sampling information (such as start time and date, duration etc.) will also be displayed. This information is helpful in making choices about changing batteries and/or formatting the flash disk prior to a new unattended sampling application or during an ongoing study.

```
========================================
Status
----------------------------------------
EMS6000 version 3.00 (6/07/96).
Current date and time: 06/05/96 07:13:33
Sensors: Temp,Cond,DO,ISE1 mV,Batt,Turb
Hardware revision: UPG3
Battery type: Alkaline
Battery voltage (Volts)      : 12.3
Free Flash disk space (KBytes): 98

** INSTRUMENT IS IN UNATTENDED MODE **

Start date and time  : 06/04/96 07:44:53
Duration (days)      : 30.000
Interval (minutes)   : 15
Site description     : Unattended Study

Hit any key to continue...
```

4.5 SYSTEM SETUP

```
=======================================
Main
---------------------------------------
1. Run                5. System setup
2. Calibrate          6. Report setup
3. File               7. Sensor setup
4. Status             8. Diagnostics

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

Select **5. System setup** from the sonde Main menu to custom configure your system with regard to parameters such as date, time, radix, communication protocol, and instrument ID.

```
=======================================
System-setup
---------------------------------------
1. Date & time       4. Batteries
2. Radix             5. Instrument ID
3. Communication     6. Page Length

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

```
1.   Date & Time
```

Select this option to choose the date format and set the correct date and time. Select a date format from the list provided. The three choices are: month/day/year, day/month/year, or year/month/day. Next enter the date and time as prompted on the screen. Press Enter after each selection.

Note: For convenience, any non-numeric key (such as space) in addition to **/** and **:** will separate the fields in the date and time entries.

```
2.   Radix
```

Select this option to choose either the period (.) or the comma (,) as the character to separate the integer and fractional parts of a number (example 99.44 or 99,44). This separating character is called a decimal point or radix mark. Choose the character which is commonly used in the country in which the 6000UPG is being used.

```
3.   Communication
```

Select this option to set up communication parameters between the 6000UPG Sonde and an outside device, such as a personal computer. The following options are available:

```
=======================================
System-setup Comm
---------------------------------------
1. RS-232 baud rate
2. RS-232 data size
3. Modem Setup
4. SDI-12 address
5. KERMIT padding

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

After you enter the number associated with the option you prefer, a list of choices will appear. Choose from the list by typing the number associated with the desired selection. See Section 9 for more details.

```
4.   Batteries
```

This option is intended to help insure that rechargeable alkaline or NiCad type batteries are not fully discharged during an unattended study. If the rechargeable alkaline battery type is selected, the 6000UPG will terminate the unattended study when the battery voltage reaches 8 volts (rather than the 6 volt cut-off for standard alkaline batteries). Currently, rechargeable alkaline battery chemistry is not well suited for long term unattended studies and battery life typically falls approximately 50% with each recharge cycle. At this time, we do not recommend the use of either recharageable alkaline or NiCad batteries for Unattended Deployment studies with the 6000UPG.

```
5.   Instrument ID
```

Select this option to record, within the sonde software, the serial number (or identification name) of the sonde. The identification will be stored in a portion of the flash memory which will not be erased when the flash disk is formatted.

```
6.   Page Length
```

Select this option to modify the page length of reports. A four line header will appear at the top of each page. The header lists all parameters which have been selected for output, see above. Setting the page length to **0** will provide a header only at the beginning of the data. Setting the value to 10 will provide one header and six lines of data (4 lines for the header + 6 lines of data = 10). You may enter any number which provides the desired report presentation.

When uploading data directly from the sonde to a computer disk drive in either Comma & " " Delimited or ASCII Text format, it is generally wise to set the page length to **0** in order to avoid gaps in the data after importing into spreadsheet software.

4.6 REPORT SETUP

```
========================================
Main
----------------------------------------
1. Run               5. System setup
2. Calibrate         6. Report setup
3. File              7. Sensor setup
4. Status            8. Diagnostics

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

Select **6. Report setup** from the sonde Main menu to configure all reports constructed by the sonde. You will be able to design the report with regard to parameters and units of measure which are viewed on the computer screen during operation. The following display will appear on selection of **Report Setup.**

```
========================================
Report-setup
----------------------------------------
1-(*) Date              G-(*) Sal ppt
2-(*) Time              H-(*) DO %
3-(c) Temp C            I-( ) DO mg/L
4-( ) Temp F            J-( ) Depth ft
5-( ) Temp K            K-( ) Depth m
6-(c) SpCond mS/cm      L-(*) pH
7-( ) SpCond uS/cm      M-( ) pH mV
8-( ) Cond mS/cm        N-( ) ORP mV
9-( ) Cond uS/cm        O-( ) NH4+ mg-N/L
A-( ) Resist MOhm*cm    P-( ) NH3 mg-N/L
B-( ) Resist KOhm*cm    Q-( ) NO3- mg-N/L
C-( ) Resist Ohm*cm     R-( ) Turb NTU
D-( ) TDS g/L           S-( ) TDG mm-Hg
E-( ) TDS kg/L          T-(*) Batt V
F-( ) TDS mg/L

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

For this example, the parameters date, time, temperature in °C, specific conductance in mS/cm, salinity, DO in percent air saturation, pH, and battery voltage will appear on the screen in all sampling and viewing applications. The "c" marker for temperature and specific conductance indicate that these parameters have conditions applied to them (See section 4.1.2).

To change the screen display using this menu, simply press the number of the parameter with its desired units to cause it to appear in the screen display associated with real-time Discrete and Conditional Sampling and with the View and Quick View options of the File Menu. When a particular choice is active, an asterisk (or a "c") will appear in the parentheses associated with the

selection. To deactivate a parameter from screen display, simply press the number of the active parameter, the asterisk will disappear, and the parameter will not appear on the screen during operation.

NOTE: Choosing or not choosing parameters from this menu does not turn sensors on and off. Regardless of how the report is set up, all active sensors will continue to collect data. See Section 4.7.

NOTE: You will see reference to TDG (total dissolved gas) in the Report setup menu. This is for possible future upgrade and is not currently available for your 6000UPG.

4.7 SENSOR SETUP

```
==========================================
Main
------------------------------------------
1. Run                  5. System setup
2. Calibrate            6. Report setup
3. File                 7. Sensor setup
4. Status               8. Diagnostics

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

Select **7. Sensor setup** to Enable or Disable (turn on or off) any sensor and to set up measurement parameters for some sensors. This option also allows you to view or change information which is specifically related to certain sensors.

```
==========================================
Sensor-setup
------------------------------------------
1-(*) Temp              7-( ) ISE2 ORP
2-(*) Cond              8-( ) ISE2 NH4+
3-(*) DO                9-( ) ISE2 NO3-
4-( ) Depth             A-(*) Batt
5-(*) ISE1 pH           B-( ) Turb
6-( ) ISE1 mV           C-( ) TDG

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

From this menu, simply press the number of the sensor which you desire to enable or disable. When a particular sensor is active, an asterisk will appear in the parentheses associated with the selection. In the example, the temperature, conductivity, dissolved oxygen, pH, and battery sensors are enabled. To disable a sensor, simply press the number of the active sensor, the asterisk will disappear, and the sensor will no longer be active.

NOTE: You will see reference to TDG (total dissolved gas) in the Sensor setup menu. This is for possible future upgrade and is not currently available for your 6000UPG.

During activation of certain sensors, you will be asked to select parameters associated with the operation of the sensor or with calculations made from data acquired by the sensor. Sensors for which additional choices are necessary are described in detail below.

```
1.  Conductivity
```

After activation of the conductivity sensor, you will be asked to enter the constant associated with the calculation of total dissolved solids (TDS), a parameter which is calculated from specific conductance. The default value of this parameter is 0.65 and any change to the value will be shown in parentheses when the prompt appears.

NOTE: If this parameter is disabled, any other parameter which is calculated using conductivity will also be disabled.

```
2.  DO
```

After activation of the dissolved oxygen sensor, you will be asked to enter the DO Warm up time associated with the Rapid Pulse Dissolved Oxygen Sensor. The default value of 40 seconds provides adequate warm-up for most applications while maintaining good battery life in long-term unattended sampling studies. While very long warm-up settings may marginally increase the accuracy of the readings, their selection will reduce battery life.

```
A.  Turbidity
```

After activation of the turbidity sensor, you will be asked to enter the number of wipes associated with mechanical cleaning of the sensor optics prior to a reading being taken. Normally, the default value of 1 is suitable, but in some applications where the potential for fouling is great, a greater number of cleaning cycles may be necessary. Additional wiping of the probe face will reduce battery life.

After entering the number of wipes, you will be prompted to enter the **Number of Samples to Average**. Entry of higher numbers such as 8 will result in greater smoothing of the data and a more average view of the turbidity in your sample, but with slightly reduced response time. Entry of lower numbers such as 1 will result in jumpier readings which reflect the momentary turbidity.

4.8 DIAGNOSTICS

```
========================================
Main
----------------------------------------
1. Run                 5. System setup
2. Calibrate           6. Report setup
3. File                7. Sensor setup
4. Status              8. Diagnostics

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

Select **8. Diagnostics** to provide diagnostic data on each installed sensor. The following display will appear, depending on the sensors which you have enabled in Sensor Setup.

```
========================================
Diagnostics
----------------------------------------
Cell Constant: 4.99621
DO gain: 1.96879
Pres offset: 0
Turbidity/TDG status: 40


===============================
    DO     ISE1     ISE2    AUX
   chrg      mV       mV    adc
-------------------------------
To exit, press <ESC>
   -0.8   -187.0    87.8     11
```

Information taken from the display in this option can be helpful for both the user and authorized service technicians in diagnosing problems which could occur with your sensors. In the lower portion of the display, **DO Chg** refers to a unitless parameter which reflects the condition of the electrode surfaces of the Rapid Pulse DO sensor. **ISE1 mv** and **ISE2 mv** refer to the voltage output of the pH sensor (ISE1) and the other potentiometric sensor which could be ammonium, nitrate, or ORP. **AUX ADC** refers to the digital output (A/D counts) of the turbidity sensor. When Diagnostics is activated, the above parameters are displayed and are updated in real-time.

In the upper portion of the display, the information is *not* updated in real-time, the values being derived from the last calibration of the particular sensors. In this section are shown the cell constant of the conductivity sensor (**Cell Constant**), the sensitivity of the pulsed DO sensor (**DO Gain**), the pressure offset of the depth sensor (**Pres Offset**), and a hexidecimal value which provides information about the function of the turbidity sensor (**Turbidity Status**).

To exit the Diagnostics mode, press Esc as prompted. The display will momentarily show the message **Initializing Sensors** and then the Main menu will appear.

5. PC6000 SOFTWARE

NOTE: If you have purchased Ecowatch for Windows for use with your Model 6000UPG, consult the Help selection in the top menu bar if you have questions on the use of this powerful Windows-based software. The following section deals with the MS-DOS-based PC6000 which is offered with all YSI logger/sampler products at no charge.

5.1 Introduction

The PC6000 program is very useful in the operation of the 6000UPG. This PC based software can be used with any IBM-compatible computer.

PC6000 enables you to:

- Configure and deploy the sonde

- Retrieve and process data from the sonde

- Capture data from the sonde

- Create a variety of reports and plots

- Print reports and plots

- Save reports and plots to disk

- Export data to other programs

The PC6000 program is completely menu-driven and easy to use. There are nine menus, but beginning users can generate reports and plots using only two menus.

Use the arrow keys to move the cursor and highlight menu options.
Use the Enter key to select a highlighted menu option.
Use the Esc key to return to a previous screen.

When each menu option is highlighted, a short, descriptive help line is displayed at the bottom of the screen.

5.2 INSTALLING THE PC6000 SOFTWARE

The PC6000 software is provided with every 6000UPG and is located in the back of this instruction manual. Use this software if you have an IBM-compatible PC with at least 300 KB of RAM and

DOS 3.0 or later. Additional RAM and the presence of a math co-processor will improve the operation of the program, but are not required.

NOTE: PC6000 imposes no limit on the number of lines a report can have, but after generating a report, only the last 300 to 2500 lines can be viewed, depending on available RAM.

A graphics adapter is required for operation of the plotting feature. One RS-232 port (also called a comm port or serial port) is required to communicate with the sonde and to capture data files. This port must be either com1 or com2.

If your system is not IBM-compatible, use a terminal emulation program with your computer.

On IBM compatible computer systems with a hard disk drive see section 2.3 for installation instructions:

On systems with two floppy disks proceed as follows:

If necessary, exit whatever program or shell is running.

1. Make sure your computer is at the A or A:\ prompt.

2. Make sure your DOS system disk is in drive A.

3. Place a new disk in drive B and format it: FORMAT B:

4. Place the original PC6000 software diskette in drive A.

5. Copy the software onto the new disk: COPY A:*.* B:

6. Store the original PC6000 software diskette in a cool clean place, away from magnets, video screens, electronic and electrical equipment and cords.

7. When you want to use the software, put the copy of the PC6000 software into drive B, put any data disk into drive A, and type: B:PC6000

Once PC6000 has loaded, the program disk can be removed from the disk drive. The disk must be reinserted into the drive prior to exit from the Setup menu if any changes have been made. This will allow the program to update the configuration file on the disk.

NOTE: If you have a non-standard video adapter and monitor (rare except on CAD work stations) you will also need to:

1.) Put your video adapter into a compatible (standard) video mode. Typically the manufacturer of the video adapter provides a program or utility to set the video mode.

2.) Type **PC6000 -V** to run the program. This tells PC6000 to send video output through the computer BIOS (built-in firmware), rather than directly to video memory. This procedure slows down the video output somewhat, but guarantees compatibility.

5.3 THE SONDE MENU

The **Sonde** option of the PC6000 software is covered in detail in Section 4 of this manual. This option emulates a VT 100 terminal which makes a direct connection between the sonde and your PC. Selecting this option will allow you to access and set up the sonde.

5.4 THE FILE MENU

Choosing **File** from the PC6000 menu bar allows you to specify and customize reports and plots based on data which has been captured from the sonde. Select **File** from the menu bar, and press Enter.

```
+-----------------------------------------------------------------------------+
¦   Sonde   File   Setup   Real-Time   Exit                      YSI PC6000  ¦
¦-----------------------------------------------------------------------------¦
¦                                                                             ¦
¦                                                                             ¦
¦                                                                             ¦
```

Filename: *.dat

At this prompt, press Enter. A list of all data files in the current directory will be displayed. Select the file you wish to retrieve from the list. If only one data file exists, that file will be loaded automatically.

To retrieve files stored on another drive or directory, at the filename: prompt, type the source drive and directory and press Enter.

Example, typing A:\PC6000\ at the prompt would provide the user with a list of all files located in the directory named PC6000 and stored on a disk in the A: drive.

1. MODIFY File Options

Any modifications performed with these functions will allow you to customize data and format reports and plots for a selected file only. See **SETUP** in this chapter to change default values permanently.

Select the **Parameters** option:

```
+------------------------------------------------------------------------------+
¦ Sonde   File   Setup   Real-Time   Exit                      YSI PC6000 ¦
¦------------------------------------------------------------------------------¦
¦                                                                              ¦
¦                                                                              ¦
¦                                                                              ¦
¦           +----------------------------------------------------+             ¦
¦           ¦  Filename:  SRUNS62O.DAT                           ¦             ¦
¦           ¦----------------------------------------------------¦             ¦
¦           ¦      MODIFY      ¦      VIEW      ¦     SYSTEM       ¦            ¦
¦           ¦------------------+----------------+------------------¦            ¦
¦           ¦  Parameters...   ¦     Header     ¦  Print Report    ¦            ¦
¦           ¦  Control Info... ¦     Report     ¦   Print Plot     ¦            ¦
¦           ¦  Scaling Info... ¦      Plot      ¦  Definitions...  ¦            ¦
¦           ¦                  ¦   Statistics   ¦     Export       ¦            ¦
¦           +----------------------------------------------------+             ¦
¦                                                                              ¦
¦                                                                              ¦
¦                                                                              ¦
¦                                                                              ¦
¦                                                                              ¦
¦------------------------------------------------------------------------------¦
¦  Modify choice of parameters (and their details) wanted in report/plot       ¦
+------------------------------------------------------------------------------+
```

The **Parameters** menu will be displayed.

```
+------------------------------------------------------------------------------+
¦ Sonde   File   Setup   Real-Time   Exit                      YSI PC6000 ¦
¦------------------------------------------------------------------------------¦
¦                                                                              ¦
¦      X-axis parameter                                                        ¦
¦      -----------------                                                       ¦
¦      Date + Time                                                             ¦
¦                                                                              ¦
¦      Y-axis parameters                                                       ¦
¦      ------------------                                                      ¦
¦      Temperature    C                                                        ¦
¦      Specific Cond  mS/cm                                                    ¦
¦      DO             mg/L                                                      ¦
¦      pH                                                                      ¦
¦      ORP            mV                                                       ¦
¦      Battery        volts                                                    ¦
¦      Turbidity      NTU                                                      ¦
¦                                                                              ¦
¦                                                                              ¦
¦                                                                              ¦
¦                                                                              ¦
¦------------------------------------------------------------------------------¦
¦  Press Enter to modify the X-axis parameter, or to select a new one.         ¦
+------------------------------------------------------------------------------+
```

Highlighting any parameter on this display will provide the following sub menu.

```
+----------------------+
¦ Add parameter here   ¦
¦ Delete this parameter ¦
¦ Move parameter up    ¦
¦ Move parameter down  ¦
¦ Detail this parameter ¦
+----------------------+
```

You may select **ONE** parameter for the X-axis, and up to 12 parameters for the Y-axis.

```
┌─────────────────────────────┐
│                             │
│   Add parameter here        │
│                             │
└─────────────────────────────┘
```

Select this option to add a parameter to a report or plot. A list of all available parameters which can be added will be displayed. Choose those parameters which you want to be included in reports and plots.

```
┌─────────────────────────────┐
│                             │
│  Delete this parameter      │
│                             │
└─────────────────────────────┘
```

Select this option to delete the highlighted parameter from reports and plots.

```
┌─────────────────────────────┐
│                             │
│  Move parameter up          │
│  Move parameter down        │
│                             │
└─────────────────────────────┘
```

Select these options to shift the highlighted parameter up or down one position. By using these options all parameters within a report and plot can be displayed in the order you prefer.

```
┌─────────────────────────────┐
│                             │
│  Detail this parameter      │
│                             │
└─────────────────────────────┘
```

Select this option to view detailed information of a highlighted parameter. PC6000 has many built-in formulae. Each formula accepts certain inputs and produces a single output. An example of this is the formula for specific conductance, which is calculated from temperature and conductivity.

Most formula inputs must be in the input data file from the sonde, but some can be entered as constants. For example, the total dissolved solids (TDS) constant can be manually entered.

Once you have selected a parameter and pressed Enter, the following screen will be displayed:

```
+--------------------------------------------------------------------------+
¦  Sonde   File   Setup   Real-Time   Exit                   YSI PC6000  ¦
¦--------------------------------------------------------------------------¦
¦                                                                          ¦
¦                                                                          ¦
¦                                                                          ¦
¦    Parameter:   Specific Cond (mS/cm)                                    ¦
¦                                                                          ¦
¦    Formula:     Temp(C)  Cond(mS/cm)                                     ¦
¦                                                                          ¦
¦    Inputs:      Temperature (C) from 6030 probe, channel 0              ¦
¦                 Conductivity (mS/cm) from 6030 probe, channel 1         ¦
¦                                                                          ¦
¦                                                                          ¦
¦                                                                          ¦
¦                                                                          ¦
¦    Compensate:                                                           ¦
¦                                                                          ¦
¦                                                                          ¦
¦                                                                          ¦
¦                                                                          ¦
¦--------------------------------------------------------------------------¦
¦  Press Enter to select a new formula for this parameter from a list      ¦
+--------------------------------------------------------------------------+
```

+-----------------------------+
| |
| Parameter: |
| |
+-----------------------------+

This line simply redisplays the parameter you have just selected.

+-----------------------------+
| |
| Formula: |
| |
+-----------------------------+

Select this option to view and change the formula used by PC6000 to calculate the selected parameter. This option will allow you to change formulae and input sources only in circumstances where multiple formulae or input sources exist. If formula options for the highlighted parameter exist, they will be displayed when pressing Enter while the formula is highlighted.

+-----------------------------+
| |
| Inputs: |
| |
+-----------------------------+

This option is reserved for future software enhancements.

```
┌─────────────────────┐
│                     │
│  Compensate:        │
│                     │
└─────────────────────┘
```

Select this option to compensate a data file for long term sensor drift. This compensation procedure is also commonly called Post-Calibration.

Example: Dissolved oxygen data can be collected periodically throughout a long term deployment using a separate, freshly calibrated DO meter. This independent data can then be used to compensate the 6000UPG data for the small sensor drift which normally occurs over time.

NOTE: The setup menu options for date format, date separator, time separator, and radix separator, all apply here. The date, time, and value are separated from each other by spaces. Lines which do not match the above format are ignored.

To create a compensation file, use a word processing program or follow the procedure below. The file must be simple ASCII. In WordPerfect you use the DOS Text Out feature. In Word, save as file type Text Only (*.TXT). From DOS, proceed as follows:

1. Issue the DOS command "COPY CON DO.CMP".

2. Type all the lines in your file (make sure each line is correct before you press Enter for that line).
> An example line would look like this:

> 12/31/92 23:59:59 100

3. After the last line has been typed and entered, hold **Ctrl** and press **Z**, then press **Enter**.

4. The message **1 File(s) copied** will be displayed.

NOTE: If only one data point is entered into the compensation file, all data after that date and time will be corrected. If more than one data point is included in the compensation file, data between points will be corrected linearly.

To enter the compensation filename, press **TAB** while the highlight cursor is on compensate. The highlight cursor will move to the right. Enter the path and file name.

Example: C:\DO.CMP   **Enter.**

When you enter a compensation filename, the program performs a test load of that compensation file. A summary is displayed so you can verify the file structure. The summary includes how many lines were accepted, rejected, or blank; the total number of lines, and the earliest and latest date.

If you compensate a constant used in calculating one parameter, you must also compensate the same constant if you use it to calculate other parameters. A total of 1000 compensation points is allowed for any single report or plot.

Appendix E of this manual is an application note which will be very helpful as you prepare for data collection to be used to compensate 6000UPG data.

Select **Control Info** from the Modify menu. The Control Info menu will be displayed

```
+------------------------------------------------------------------------------+
¦  Sonde   File   Setup   Real-Time   Exit                      YSI PC6000  ¦
¦------------------------------------------------------------------------------¦
¦                                                                              ¦
¦                                                                              ¦
¦                                                                              ¦
¦             +-----------------------------------------------------+          ¦
¦             ¦   Filename:  SRUNS62O.DAT                           ¦          ¦
¦             ¦------------------------------------------------------          ¦
¦             ¦       MODIFY       ¦      VIEW      ¦     SYSTEM     ¦          ¦
¦             ¦------------------+-----------------+----------------¦          ¦
¦             ¦    Parameters... ¦     Header      ¦   Print Report ¦          ¦
¦             ¦   **Control Info**... ¦     Report      ¦   Print Plot   ¦          ¦
¦             ¦    Scaling Info...¦      Plot       ¦  Definitions...¦          ¦
¦             ¦                   ¦    Statistics   ¦     Export     ¦          ¦
¦             +-----------------------------------------------------+          ¦
¦                                                                              ¦
¦                                                                              ¦
¦                                                                              ¦
¦                                                                              ¦
¦                                                                              ¦
¦------------------------------------------------------------------------------¦
¦  View or change the title or timing information for the report/plot          ¦
+------------------------------------------------------------------------------+
```

The **Control Info** menu allows you to report or plot an entire file, or any portion of a file. Other options on the Control Info menu allow you to average several data points together and set up reports and plots to display data in the format you choose.

```
+------------------------------------------------------------------------------+
¦  Sonde   File   Setup   Real-Time   Exit                      YSI PC6000  ¦
¦------------------------------------------------------------------------------¦
¦                                                                              ¦
¦   Enter title line                                                           ¦
¦   SRUNS62O.DAT                                                               ¦
¦                                                                              ¦
¦   First sample was at:       05/03/96  8:15:00                               ¦
¦   Enter start time:          begin                                           ¦
¦   Enter stop time:           end                                             ¦
¦   Last sample was at:        06/01/96 19:00:00                               ¦
¦                                                                              ¦
¦   Logging interval was:      900 seconds                                     ¦
¦   Enter averaging interval:  0                                               ¦
¦                                                                              ¦
¦   X-axis time per screen:    42405                                           ¦
¦                                                                              ¦
¦   Cross-parameter style:     AVG                                             ¦
¦   Cross-parameter bins:      100   (maximum 2550)                            ¦
¦                                                                              ¦
¦   Parameters per plot:       2                                               ¦
¦                                                                              ¦
¦------------------------------------------------------------------------------¦
¦   Enter a title for the report or plot (it will be centered for you)         ¦
+------------------------------------------------------------------------------+
```

Enter title line

Select this option to assign a title which will appear on all reports and plots.

```
First sample was at:
Enter start time:
Enter stop time:
Last sample was at:
```

Select these options to view start and stop times of the file, and specify portions of the file to report or plot. The first and last line of this block of information indicates the actual start and stop time of the current file. You can identify any segment of time from within a file to report and plot data. For example, if the duration of the deployment was five days, but you wish to see a report and plot for only day three, simply enter the start and stop dates and times associated with day three. Even though all five days of data are retained, reports and plots will show only day three.

```
Logging interval was:
Enter averaging interval:
```

This option shows the sampling interval which was in effect throughout the deployment. You may choose to average several data points together for reporting and plotting. For example, if the 6000UPG readings were captured every 900 seconds (15 minutes) during the deployment, you might want the reports and plots to average four of these readings together so that the information can be reported or plotted on an hourly basis. To do this, define an averaging interval of 3600 seconds.

```
X-axis time per screen:
```

Select this option to specify the time interval on the X-axis. This line is only applicable when Date + Time have been defined for the X-axis (see **Parameters** above). You can define the width of a given plot screen in minutes by changing the number of minutes in this option.

```
Cross-parameter style:
```

Select this option to choose one of four plot styles. This option is only applicable if a parameter other than Date + Time is selected for the X-axis (see **Parameters** above).

An averaged plot **(AVG)** assumes a correlation between the X-axis parameter and the Y axis parameters. The averaged plot divides the X axis into 100 equal-sized memory bins. Each sample is tallied into the appropriate memory bin based on its X-axis value. When finished, the average value for each Y-axis parameter in each memory bin is displayed.

A sequential plot **(SEQ)**, plots each point successively as it comes from the data file. A sequential plot provides more detail on the data than an averaged plot, but can appear rather messy.

The increase **(INC)** and decrease **(DEC)** plots are types of sequential plots. An increasing plot only displays points when the X-axis values are increasing. A decreasing plot only displays points when the X-axis values are decreasing. The increasing and decreasing sequential plots are especially useful if you are profiling and display depth on the X axis. Thus the plot shows only the time in which the sonde is being lowered or raised.

```
Cross-parameter bins:   100   (maximum xxxx)
```

Select this option to set up the number of bins which will appear on the X-axis. This feature only applies to reports and averaged plots (see above) with a parameter other than Date + Time on the X axis. Changing this value modifies the number of bins into which the X-axis is divided. The smaller the number of bins, the wider and more general is the plotted information. The maximum number of allowable bins varies with the capability of your computer system, and is displayed in parentheses.

```
Parameters per plot:
```

Select this option to setup the number of parameters which will be plotted together. If you choose 1, there will be an individual X and Y axis displayed for each selected parameter. Select any number of parameters per plot, (from 1 to 4) which provides your data with the best plot presentation.

Select the **Scaling Info** menu option

```
+----------------------------------------------------------------------------+
¦  Sonde   File   Setup   Real-Time   Exit                     YSI PC6000  ¦
¦----------------------------------------------------------------------------¦
¦                                                                            ¦
¦                                                                            ¦
¦                                                                            ¦
¦            +------------------------------------------------------+        ¦
¦            ¦  Filename:  SRUNS62O.DAT                             ¦        ¦
¦            ¦------------------------------------------------------¦        ¦
¦            ¦     MODIFY     ¦      VIEW     ¦      SYSTEM          ¦        ¦
¦            ¦----------------+---------------+---------------------¦        ¦
¦            ¦   Parameters... ¦    Header     ¦   Print Report     ¦        ¦
¦            ¦   Control Info... ¦   Report     ¦    Print Plot      ¦        ¦
¦            ¦   **Scaling Info**... ¦    Plot      ¦   Definitions...   ¦        ¦
¦            ¦                ¦   Statistics  ¦    Export          ¦        ¦
¦            +------------------------------------------------------+        ¦
¦                                                                            ¦
¦                                                                            ¦
¦                                                                            ¦
¦                                                                            ¦
¦----------------------------------------------------------------------------¦
¦  View or change scaling technique, minima, and maxima                      ¦
+----------------------------------------------------------------------------+
```

There are three scaling options.

```
+----------------------------------------------------------------------------+
¦  Sonde   File   Setup   Real-Time   Exit                     YSI PC6000  ¦
¦----------------------------------------------------------------------------¦
¦  Scaling technique: automatic                                              ¦
¦  Copy default to manual                                                    ¦
¦  Copy automatic to manual      Default         Manual         Automatic    ¦
¦                                Scaling         Scaling         Scaling     ¦
¦  Parameter      Units     Minimum Maximum  Minimum Maximum  Minimum Maximum ¦
¦  -----------    --------  ------- -------  ------- -------  ------- ------- ¦
¦  Temperature    C            -5      45      -5      45      -5      45    ¦
¦  Specific Cond  mS/cm         0     235       0     235       0     235    ¦
¦  DO             mg/L          0      20       0      20       0      20    ¦
¦  pH                           2      14       2      14       2      14    ¦
¦  ORP            mV        -1000    1000   -1000    1000   -1000    1000    ¦
¦  Battery        volts         0      30       0      30       0      30    ¦
¦  Turbidity      NTU           0    1000       0    1000       0    1000    ¦
¦                                                                            ¦
¦                                                                            ¦
¦                                                                            ¦
¦                                                                            ¦
¦                                                                            ¦
¦----------------------------------------------------------------------------¦
¦  Select scaling technique (default, manual, automatic)                     ¦
+----------------------------------------------------------------------------+
```

Default scaling offers fixed limits. These limits correspond to the range of each parameter as defined by the sensor specifications, so your plot will always fit within these limits.

Manual scaling allows you to enter custom limits for each parameter.

Automatic scaling. The computer scans the data file and determines its limits, then displays those limits on the plot.

NOTE: When entering a scaling technique, you need only type the first letter of the desired technique and press Enter. PC6000 will fill in the rest.

```
Copy default to manual
Copy automatic to manual
```

Select these options to provide a quick way to copy from either the default or automatic limits columns to the manual scaling column. Once data has been copied into the manual scaling column, it can be modified. After copying is complete, any previous manual limits you may have defined will be lost.

Default scaling

This column shows the default scaling limits. These limits cannot be changed.

Manual scaling

This column shows the manual scaling limits which you can modify.

Automatic scaling

This column shows the automatic scaling limits. These limits can not be changed, but are updated each time an automatically scaled plot is generated.

2. VIEW File Options

All of the **View** options allow you to view file data on the screen.

```
+--------------------------------------------------------------------------------+
¦  Sonde   File   Setup   Real-Time   Exit                        YSI PC6000  ¦
¦--------------------------------------------------------------------------------¦
¦                                                                                ¦
¦                                                                                ¦
¦                                                                                ¦
¦           +-------------------------------------------------------+            ¦
¦           ¦   Filename:  SRUNS620.DAT                             ¦            ¦
¦           ¦-------------------------------------------------------¦            ¦
¦           ¦      MODIFY     ¦      VIEW       ¦     SYSTEM         ¦            ¦
¦           ¦-----------------+-----------------+-------------------¦            ¦
¦           ¦    Parameters...¦     **Header**    ¦   Print Report    ¦            ¦
¦           ¦    Control Info...¦     Report    ¦    Print Plot      ¦            ¦
¦           ¦    Scaling Info...¦      Plot      ¦   Definitions...  ¦            ¦
¦           ¦                 ¦   Statistics    ¦     Export        ¦            ¦
¦           +-------------------------------------------------------+            ¦
¦                                                                                ¦
¦                                                                                ¦
¦                                                                                ¦
¦                                                                                ¦
¦--------------------------------------------------------------------------------¦
¦  Press Enter to view header information about the file                         ¦
+--------------------------------------------------------------------------------+
```

Select the **Header** menu option to display complete information about the sonde, probes, and configuration of the current file.

```
+--------------------------------------------------------------------------------+
¦  Sonde   File   Setup   Real-Time   Exit                        YSI PC6000  ¦
¦--------------------------------------------------------------------------------¦
¦                                                                                ¦
¦                                                                                ¦
¦                                                                                ¦
¦           +-------------------------------------------------------+            ¦
¦           ¦   Filename:  SRUNS620.DAT                             ¦            ¦
¦           ¦-------------------------------------------------------¦            ¦
¦           ¦      MODIFY     ¦      VIEW       ¦     SYSTEM         ¦            ¦
¦           ¦-----------------+-----------------+-------------------¦            ¦
¦           ¦    Parameters...¦      Header     ¦   Print Report    ¦            ¦
¦           ¦    Control Info...¦     **Report**    ¦    Print Plot      ¦            ¦
¦           ¦    Scaling Info...¦      Plot      ¦   Definitions...  ¦            ¦
¦           ¦                 ¦   Statistics    ¦     Export        ¦            ¦
¦           +-------------------------------------------------------+            ¦
¦                                                                                ¦
¦                                                                                ¦
¦                                                                                ¦
¦                                                                                ¦
¦--------------------------------------------------------------------------------¦
¦  Generate a report on the screen                                              ¦
+--------------------------------------------------------------------------------+
```

Select the **Report** menu option to display a complete list of all readings (as defined by the settings in the **Modify** portion of the menu) from the current file to the screen. As the report is scrolled onto the screen, it can be paused at any time by pressing any key. Once the entire report has been displayed, use the arrow keys, the page up and page down keys, or the home and end keys to move to any location within the report. If your computer system has limited RAM, early data points within a report may become unavailable for viewing. To redisplay unavailable data points, simply redisplay the report from the beginning.

```
+----------------------------------------------------------------------+
¦ Sonde    File    Setup    Real-Time    Exit                YSI PC6000 ¦
¦----------------------------------------------------------------------¦
¦                                                                      ¦
¦                                                                      ¦
¦           +--------------------------------------------------+       ¦
¦           ¦  Filename:   SRUNS62O.DAT                        ¦       ¦
¦           ¦------------------------------------------------- ¦       ¦
¦           ¦     MODIFY      ¦      VIEW      ¦     SYSTEM     ¦       ¦
¦           ¦-----------------+---------------+----------------¦       ¦
¦           ¦   Parameters... ¦    Header     ¦  Print Report  ¦       ¦
¦           ¦   Control Info..¦    Report     ¦   Print Plot   ¦       ¦
¦           ¦   Scaling Info..¦    **Plot**   ¦  Definitions...¦       ¦
¦           ¦                 ¦   Statistics  ¦    Export      ¦       ¦
¦           +--------------------------------------------------+       ¦
¦                                                                      ¦
¦                                                                      ¦
¦                                                                      ¦
¦                                                                      ¦
¦                                                                      ¦
¦----------------------------------------------------------------------¦
¦  Generate a plot on the screen                                       ¦
+----------------------------------------------------------------------+
```

Select the **Plot** menu option to display a plot of the current data file to the screen. The plot can be customized, see **Parameters** and **Control Info** above. A plot can be abandoned at any time by pressing Esc, or paused by striking any other key. If a plot is too large to fit on one screen, it will automatically move to a new screen.

```
+----------------------------------------------------------------------+
¦ Sonde    File    Setup    Real-Time    Exit                YSI PC6000 ¦
¦----------------------------------------------------------------------¦
¦                                                                      ¦
¦                                                                      ¦
¦           +--------------------------------------------------+       ¦
¦           ¦  Filename:   SRUNS62O.DAT                        ¦       ¦
¦           ¦------------------------------------------------- ¦       ¦
¦           ¦     MODIFY      ¦      VIEW      ¦     SYSTEM     ¦       ¦
¦           ¦-----------------+---------------+----------------¦       ¦
¦           ¦   Parameters... ¦    Header     ¦  Print Report  ¦       ¦
¦           ¦   Control Info..¦    Report     ¦   Print Plot   ¦       ¦
¦           ¦   Scaling Info..¦    Plot       ¦  Definitions...¦       ¦
¦           ¦                 ¦  **Statistics**¦   Export      ¦       ¦
¦           +--------------------------------------------------+       ¦
¦                                                                      ¦
¦                                                                      ¦
¦                                                                      ¦
¦                                                                      ¦
¦                                                                      ¦
¦----------------------------------------------------------------------¦
¦  View statistics from the most-recently generated report/plot        ¦
+----------------------------------------------------------------------+
```

Select the **Statistics** menu option to view statistics of a data file, or portion of a data file. As with reports and plots, the displayed statistics are affected by the choices you have made in the **Parameters**, and the **Control info** menus described previously. To view statistics for a portion of a file enter the start and stop times in **Control Info**. Statistics are only available after a report or plot is run.

```
+------------------------------------------------------------------------+
| Sonde   File   Setup   Real-Time   Exit                    YSI PC6000  |
|------------------------------------------------------------------------|
|                                                                        |
|                                                                        |
|   Sensor Type                  Minimum     Maximum     Mean    Std.Dev.|
|                                                                        |
|   Temperature (C)               10.20       27.34      14.60     2.365 |
|   Specific Cond (mS/cm)          0.00        0.82       0.76     0.099 |
|   DO (mg/L)                      7.50       10.86       8.80     0.638 |
|   pH                             6.85        7.61       7.33     0.108 |
|   ORP (mV)                      400.3       513.3      446.4     15.93 |
|   Battery (volts)               10.3        12.8       11.0      0.46  |
|                                                                        |
|                                                                        |
|   Number of samples = 2828                                             |
|                                                                        |
|                                                                        |
|                                                                        |
|                                                                        |
|                                                                        |
|                                                                        |
|------------------------------------------------------------------------|
|  View statistics.   Press F2 to print.   Press Esc to return...        |
+------------------------------------------------------------------------+
```

To print a copy of the statistics screen, press the F2 key.

3. SYSTEM File Options

SYSTEM menu options allow you to print the report and plot, or export data to some other software program. The specific setup format of the report or plot can also be frozen for future access.

```
+------------------------------------------------------------------------+
| Sonde   File   Setup   Real-Time   Exit                     YSI PC6000 |
|------------------------------------------------------------------------|
|                                                                        |
|                                                                        |
|                                                                        |
|         +----------------------------------------------------+         |
|         | Filename:  SRUNS62O.DAT                            |         |
|         |----------------------------------------------------|         |
|         |      MODIFY     |      VIEW      |     SYSTEM       |         |
|         |-----------------+---------------+------------------|         |
|         |   Parameters... |     Header    |   Print Report   |         |
|         |   Control Info... |    Report   |    Print Plot    |         |
|         |   Scaling Info... |     Plot    |   Definitions... |         |
|         |                 |   Statistics  |      Export      |         |
|         +----------------------------------------------------+         |
|                                                                        |
|                                                                        |
|                                                                        |
|                                                                        |
|                                                                        |
|------------------------------------------------------------------------|
| Generate a report on the printer (and screen)                          |
+------------------------------------------------------------------------+
```

Select the **Print Report** option to send your report to the printer. After you select this option, a prompt will appear on the screen asking if your printer is ready. Press Enter to proceed with the print operation. If more than 8 parameters are to be printed, PC6000 will assume you have a wide-carriage printer. If your printer is not wide-carriage, set your printer to compress mode before printing (see your printer's manual for instructions).

Note: The printer port option (in the setup menu) specifies the computer port to which the report will be sent.

```
+------------------------------------------------------------------------+
| Sonde   File   Setup   Real-Time   Exit                     YSI PC6000 |
|------------------------------------------------------------------------|
|                                                                        |
|                                                                        |
|                                                                        |
|         +----------------------------------------------------+         |
|         | Filename:  SRUNS62O.DAT                            |         |
|         |----------------------------------------------------|         |
|         |      MODIFY     |      VIEW      |     SYSTEM       |         |
|         |-----------------+---------------+------------------|         |
|         |   Parameters... |     Header    |   Print Report   |         |
|         |   Control Info... |    Report   |    Print Plot    |         |
|         |   Scaling Info... |     Plot    |   Definitions... |         |
|         |                 |   Statistics  |      Export      |         |
|         +----------------------------------------------------+         |
|                                                                        |
|                                                                        |
|                                                                        |
|                                                                        |
|                                                                        |
|------------------------------------------------------------------------|
| Generate a plot on the printer (and screen)                            |
+------------------------------------------------------------------------+
```

Select the **Print Plot** option to send your plot to the printer. After you select this option, a prompt will appear on the screen asking if your printer is ready. Press Enter to proceed with the print operation. Printing takes place after the plot is completely drawn on the screen.

Note: The printer port option (in the setup menu) specifies the computer port to which the report will be sent.

```
+----------------------------------------------------------------------+
¦  Sonde   File   Setup   Real-Time   Exit                  YSI PC6000  ¦
¦----------------------------------------------------------------------¦
¦                                                                      ¦
¦                                                                      ¦
¦          +------------------------------------------------+         ¦
¦          ¦   Filename:   SRUNS62O.DAT                      ¦         ¦
¦          ¦------------------------------------------------¦         ¦
¦          ¦     MODIFY      ¦      VIEW     ¦    SYSTEM      ¦         ¦
¦          ¦-----------------+--------------+----------------¦         ¦
¦          ¦   Parameters... ¦    Header    ¦  Print Report  ¦         ¦
¦          ¦   Control Info...¦    Report    ¦   Print Plot   ¦         ¦
¦          ¦   Scaling Info...¦     Plot     ¦  **Definitions...** ¦     ¦
¦          ¦                 ¦  Statistics  ¦    Export      ¦         ¦
¦          +------------------------------------------------+         ¦
¦                                                                      ¦
¦                                                                      ¦
¦                                                                      ¦
¦                                                                      ¦
¦----------------------------------------------------------------------¦
¦  Select, modify, or create definitions of reports/plots              ¦
+----------------------------------------------------------------------+
```

Select the **Definitions** option to create and save different report or plot configurations from the same data file. Each different file will contain all options and setup information you have defined in the modify menus. See the **MODIFY** options earlier in this section. After you have selected **Definitions** from the SYSTEM menu, the following menu will be displayed.

```
+----------------------------------------------------------------------+
¦  Sonde   File   Setup   Real-Time   Exit                  YSI PC6000  ¦
¦----------------------------------------------------------------------¦
¦                                                                      ¦
¦          Active definition:   default report/plot                   ¦
¦                                                                      ¦
¦          Select an action:    Select a definition                   ¦
¦                               Create new definition                 ¦
¦                               Rename active definition              ¦
¦                               Delete active definition              ¦
¦                               Clear active definition               ¦
¦                                                                      ¦
¦                                                                      ¦
¦                                                                      ¦
¦                                                                      ¦
¦                                                                      ¦
¦                                                                      ¦
¦----------------------------------------------------------------------¦
¦  Select a definition to be active                                    ¦
+----------------------------------------------------------------------+
```

Active definition:

Select this option to display the name of the current active definition.

Select a definition:

Select this option to retrieve an old definition.

Create new definition:

Select this option to create a new report and plot format which you will specify by variation of the current format after the new format has been named. For example, if you want to report and plot only dissolved oxygen readings in mg/L for your study instead of all parameters, first create a new definition at the prompt by typing "DO" (or any other designation of your choice). Then exit the definition menu by pressing Esc. Scroll to the Parameters menu and eliminate all parameters except DO, mg/L.   This data presentation can then be reported, plotted, or exported, but more importantly, if you return to this data file at a later time, the "DO" definition can always be selected to provide this same data format since it has been saved under its own designation.

Remember: Always name the new definition in the "create new designation" option prior to making changes which will define the new format.

Rename active definition:

Select this option to change the name of the active definition.

Delete active definition:

Select this option to remove the active definition from the file.

Clear active definition:

Select this option to reset the active definition to default values. Thus all customization features you previously set up are reset to default values.

```
+---------------------------------------------------------------------------+
| Sonde   File   Setup   Real-Time   Exit                    YSI PC6000   |
|---------------------------------------------------------------------------|
|                                                                           |
|                                                                           |
|          +-----------------------------------------------------+          |
|          | Filename:  SRUNS62O.DAT                             |          |
|          |-----------------------------------------------------|          |
|          |     MODIFY     |     VIEW      |     SYSTEM         |          |
|          |----------------+---------------+--------------------|          |
|          |   Parameters... |     Header    |   Print Report    |          |
|          |   Control Info... |     Report   |    Print Plot     |          |
|          |   Scaling Info... |     Plot     |   Definitions...  |          |
|          |                 |   Statistics  |      **Export**       |          |
|          +-----------------------------------------------------+          |
|                                                                           |
|                                                                           |
|                                                                           |
|                                                                           |
|---------------------------------------------------------------------------|
|  Generate a report and send it to a disk file (and screen)               |
+---------------------------------------------------------------------------+
```

Select the **Export** menu option to export a data file to another program. After selecting the Export option you will be asked to name the file to be exported. The default name is the same as the current data file with the extension PRN or CDF, depending on the export format selected. Export formats are selected in the Advanced Setup menu; see Section 5.5. After the file has been exported to disk, it can be retrieved using any program you choose. This feature is especially useful when exporting to a database or a spreadsheet program. Follow the importing instructions outlined in the destination program to retrieve the export file you have created.

5.5 THE SETUP MENU

Choosing the **Setup** option from the menu bar allows you to configure the PC program to your specifications. Highlight **Setup**, from the menu bar and press Enter.

```
+------------------------------------------------------------------------------+
¦  Sonde   File   Setup   Real-Time   Exit                        YSI PC6000   ¦
¦------------------------------------------------------------------------------¦
¦                                                                              ¦
¦                                                                              ¦
```

The setup menu will be displayed:

```
+------------------------------------------------------------------------------+
¦  Sonde   File   Setup   Real-Time   Exit                        YSI PC6000   ¦
¦------------------------------------------------------------------------------¦
¦                                                                              ¦
¦                                                                              ¦
¦                                                                              ¦
¦     -----DISPLAY-FORMATS-----      -----------COMPUTER-CONNECTIONS-----------¦
¦     Date format:      mdy          Comm port:       1                        ¦
¦     Date separator:   /            Baud rate:       9600                     ¦
¦     Time separator:   :            Printer port:    1                        ¦
¦     Radix mark:       .            Printer type:    HP LaserJet laser        ¦
¦                                                                              ¦
¦                                                                              ¦
¦     -------MORE-SETUP--------      ------------COMPUTER-DISPLAY------------   ¦
¦     Data capture setup...          Menu colors:     Bering Sea (color)       ¦
¦     Advanced Setup...              Plot colors:     Ohio River (color)       ¦
¦                                    Graphics mode:   Automatic selection hi-res¦
¦                                                                              ¦
¦                                                                              ¦
¦                                                                              ¦
¦                                                                              ¦
¦                                                                              ¦
¦------------------------------------------------------------------------------¦
¦  Press Enter to access advanced setup items                                  ¦
+------------------------------------------------------------------------------+
```

Other than the Comm port and Printer port options, the default values are adequate to perform virtually every function of the 6000UPG.

```
+----------------------------+
¦                            ¦
¦ Comm port:     1           ¦
¦ Baud rate:     9600        ¦
¦                            ¦
+----------------------------+
```

Select these options if it is necessary to change the default communications setup. These options must be properly set before attempting to communicate with the software inside the sonde. See Section 4.5. If you have difficulty communicating with the sonde, change the comm port and try again. PC6000 allows only Comm port 1 or 2.

The baud rate can be changed by highlighting it and pressing Enter. Select from a list of possible baud rates which will be displayed. The baud rate you select here **must match** the baud rate set in the sonde (which defaults to 9600). See Section 4.3.

```
Date format:      MDY
Date separator:   /
Time separator:   :
Radix mark:       .
```

Select any of these options to change them from their default. Users may specify any order of day (D), month (M), and year (Y) by selecting **Date format**.. The other options are used primarily outside of the US where other characters are sometimes used to separate numbers in dates, times, or decimals.

```
Printer port:     1
Printer type:     HP LaserJet laser
```

Select these options to tell PC6000 about your computer system's printer and how it is connected. If you have difficulty printing, specify a different printer port here (1, 2, or 3) and try again.
Select the **Printer type:** option to provide a list of printers which are supported by PC6000. Select a printer that best describes your system's printer. If you have difficulty printing, try a different selection here. It may also be necessary to consult the printer instruction manual to determine what type of printer your printer emulates.

NOTE: The printer type option only affects plot output and has no effect on report printing.

```
Menu colors
Plot colors
Graphic Mode
```

Select these options to tell PC6000 what type of monitor your computer has, and change the colors of both menus and plots as they are displayed on the screen. These color selections have no effect on the printed output of reports and plots. If none of the color schemes are to your liking, you can setup a User Defined color scheme. See Section 5.7.

From the list provided, choose a graphics mode which best matches your video adapter and monitor. If you have difficulty, consult your video adapter's instruction manual.

```
Data Capture Setup
```

See section 5.6 for a detailed explanation of this menu.

Advanced Setup

See Section 5.7 for a detailed explanation of this menu.

5.6 DATA CAPTURE / REAL-TIME SETUP

Once the Real-time mode has been properly set up, you will be able to view the data in real-time as it is taken in the Discrete Sample mode by the sonde. Each reading is displayed at the bottom of the real-time screen, and plots are updated with the arrival of each data point. In addition, the data will be automatically stored to the disk drive (hard or floppy) which you select. The setup process is not difficult, but you should follow the instructions in the following section *exactly* to be sure of successful operation in this mode.

STEP 1. Access the Sonde from the PC6000 menu bar and **Start sampling**. Make certain that the parameters which you want to view in real time and are displayed correctly. Adjust these parameters, if necessary, via the **Report Setup** menu of the Sonde software. Once the proper parameters are displayed to the screen, exit the Sonde menu structure by pressing **F10** and return to the menu bar of the PC6000 software.

STEP 2: Select **Setup** from the PC6000 menu bar, and then **Data capture setup,** pressing Enter after each entry. Access the **Parser** of this menu with the arrow keys and make certain that it is set to 6000. If not, type 6000 at the prompt, and press Enter. Next access the **Site Name** portion of the menu and enter any appropriate name. This name is provided for identifying purposes only. It is displayed on the File Header Menu, and it appears on the Real-Time plot screen and Real-Time plot printout. Now access the **Filename** portion of the menu and enter the name of the file under which you wish your data to be stored, and press Enter. Now access the **Auto-configure** entry of the menu, and press Enter. There will be a 5-10 second delay while the PC6000 software examines the sonde software to determine the parameters which you have decided to view in real-time. When the process is complete, the these parameters will appear in the list in the lower portion of the **Data capture setup** menu.

STEP 3: Set up the display which will be viewed in real-time. First, set the **X-axis time per screen** in minutes. Next, set the **Parameters per plot** which can be a value from 1 to 4. Finally, set the **Beep notification** to indicate the acquisition of either good data, bad data, or all data (both). Bad data is defined as that which, when arriving from the sonde, contains errors in the communication protocol and is rarely observed. If you prefer, you can eliminate the beep function completely by selecting off. Be sure to press Enter after each entry.

STEP 4: Set the scaling for each of the parameters in the lower right portion of the menu. There is no automatic scaling in this mode, so you should select the manual scaling ranges which will result in meaningful display of your data. These selections will become easier with experience. Use the Tab key to move from **Minimum** to **Maximum** and the arrow keys to move vertically when carrying out this operation. Be sure to press Enter after each scaling entry.

STEP 5: After entering scaling factors, exit to the PC6000 menu bar by pressing Esc twice. Then access the **Sonde** portion of the PC6000 menu and press Enter. Type "Menu" at the # prompt and press Enter. Select the **Run** menu, and begin sampling at the sample interval which is suitable for

you study. *While the discrete sample mode is still operative, exit. to the PC6000 menu bar by pressing* F10 *(do not press* Esc *or the sampling will be terminated).*

STEP 6: From the PC6000 menu bar, select **Real-Time** and press Enter. The **Discrete Sample** data from the sonde will be plotted on the display and will be logged to disk automatically under your designated file name.

COMMON CAUSES OF ERRORS IN REAL-TIME MODE:

1. The "Parser" is not set to "6000". Set the Parser to "6000"

2. You have selected more parameters in the **Sonde Report Setup** than can be viewed on the computer screen. Remove time and date and/or other less important parameters in the Report Setup Menu so that all selected parameters are visible in **Discrete Sample** display.

3. The name which you entered for your data file already exists on your storage disk, but the file format for the initial study is different from the current file format. Change the name of the data file or delete the existing data file of this name from your disk.

4. You exited the **Discrete Sample** mode of the sonde software using Esc rather than F10. Return to the Sonde menu and select **Run**. Restart the **Start sampling** mode and exit with F10 to the PC6000 menu bar. Choose **Real-Time** and press Enter.

5.7 ADVANCED SETUP

From the PC6000 menu bar, select **Setup**. The setup menu will be displayed.

```
+------------------------------------------------------------------------------+
| Sonde   File   Setup   Real-Time   Exit                      YSI PC6000      |
|------------------------------------------------------------------------------|
|                                                                              |
|                                                                              |
|                                                                              |
|    -----DISPLAY-FORMATS-----      ----------COMPUTER-CONNECTIONS-----------   |
|   Date format:    mdy           Comm port:       2                          |
|   Date separator:  /            Baud rate:       9600                       |
|   Time separator:  :            Printer port:    1                          |
|   Radix mark:      .            Printer type:    HP LaserJet laser          |
|                                                                              |
|                                                                              |
|    -------MORE-SETUP--------      ------------COMPUTER-DISPLAY------------    |
|   Data capture setup...         Menu colors:     Bering Sea (color)         |
|   Advanced Setup...             Plot colors:     Ohio River (color)         |
|                                 Graphics mode:   Automatic selection hi-res |
|                                                                              |
|                                                                              |
|                                                                              |
|                                                                              |
|------------------------------------------------------------------------------|
| Press Enter to access advanced setup items                                   |
+------------------------------------------------------------------------------+
```

Select this option to display the following menu.

```
+-------------------------------------------------------------------------------+
¦  Sonde   File   Setup   Real-Time   Exit                        YSI PC6000  ¦
¦-------------------------------------------------------------------------------¦
¦                                                                               ¦
¦                                                                               ¦
¦                                                                               ¦
¦     ------------GLOBAL-SWITCHES-----------      ----------EXPORT----------    ¦
¦     Default scaling technique:    automatic   Export file format:    prn     ¦
¦     Default parameters per plot:  2           Export date format:    form    ¦
¦     Full-screen sonde menu:       no          Export header format:  -       ¦
¦     Multiple formula query:       yes         CDF delimiter:         ,       ¦
¦                                                                               ¦
¦     --------------DATA-FILES--------------                                    ¦
¦     Default data directory:                                                   ¦
¦                                                                               ¦
¦     -------------USER-DEFINED-------------                                    ¦
¦     User-defined menu colors...                                              ¦
¦     User-defined plot colors...                                              ¦
¦     User-defined printer control codes:                                      ¦
¦                                                                               ¦
¦                                                                               ¦
¦                                                                               ¦
¦                                                                               ¦
¦-------------------------------------------------------------------------------¦
¦   The scaling technique for new plots (default, manual, automatic)           ¦
+-------------------------------------------------------------------------------+
```

It is important to remember that the default values assigned to these options will be correct for most operations. These options are provided for the advanced user who has special requirements of PC6000.

NOTE: Most changes in the Advanced Setup Menu require the user to press Enter after the parameter is altered.

Full-screen sonde menu: Y

Select this option to specify whether terminal emulation should use the entire PC screen, or should take place within the usual border drawn by the PC software.

Export date format: FORM

Select this option to choose from a variety of date formats for the exported data.

FORM (formatted):

MM/DD/YY and HH:MM:SS.

SEP (separated):

6 numeric values (m,d,y,h,m,s).

COMB (combination):

YYYYMMDD and a string of the form HH:MM:SS.

JUL (Julian):

A ten-digit integral number of seconds past midnight March 1, 1984. **NUM** (numeric):

A fixed point number of the form DDDDDD.TTTTTT where DDDDDD is the number of days past December 31 1899, and where TTTTTT is the fractional part of the day which has elapsed (.750000 is 6 PM).

REL (relative):

A fixed point number of the form HHHH.HHHH giving the number of hours elapsed since the first sample in the file.

NOTE: The export date format only applies to CDF and SDF export files. The date and time formats displayed on the PC6000 screen are determined in the **SETUP** menu.

| Export header format: -- |

Select this option to specify what header lines (if any) should be included at the top of CDF and SDF export files. The header can contain up to three lines.

(-): No header lines.

P: One header line, containing the name of each Parameter.

U: One header line, containing the name of each Unit.

T: One header line, containing the name of the report Title.

| Multiple formula query: N |

Select this option to change the characteristics of a derived parameter. This option should be set to N for no, except for advanced users.

| User-Defined menu colors |

Select this option to customize the menu colors of PC6000. Changing the colors using this option will permanently modify the color scheme of **User Defined Colors** in the **Setup** menu.

To use this feature, select a menu item to be changed from the lists provided. Find the box which has the same title as the item you selected. Watch the box as you press enter repeatedly to scroll through the various color options. Stop scrolling when the desired color is displayed and press Esc. Continue this process until all colors are as you prefer.

> User-Defined plot colors

Select this option to modify the plot colors of PC6000. As detailed in the User-defined menu colors section above, select a plot item to be changed from the list provided and press Enter. Watch the sample plot as you repeatedly press Enter. Press Esc when the item color you prefer is displayed. Repeat this process until all plot colors are as you prefer.

> Default Data Directory:

Select this option to specify the drive and directory to which you want all PC6000 files to be stored. Type the drive and directory to which you wish all PC6000 data files to be stored when captured from the sonde.

Example: Typing C:\PC6000 would save all data files to the C:\ drive and to a directory called PC6000.

> User-defined printer control codes:

Select this option to manually enter special printer commands. Consult your printer's instruction manual for the specific commands compatible with your printer.

> Export file format: PRN

Select this option to setup a format if you wish to export data to another program; see Section 5.4. The correct format to specify is determined by the software to which you want to export data. Consult the manual of the destination software to determine the compatible format.

The three export format choices PC6000 allows are:

> Printer format (PRN):

Select this option to export data in exactly the same format as it would be sent to a printer. All page headings, column headings, and formfeeds are present in the export file.

> Comma & " " delimited format (CDF):

Select this option to export data in a format which encases all strings of data in double quotes, and separates each option on each line with a comma (or other delimiter character). There will be no spaces on any line unless they are inside a string.

Example: "12/31/92","23:59:59",123.45,12.3,123

Space delimited format (SDF):

Select this option to export data in a format with fixed-column fields, which can be string or numeric. Strings and dates are left-adjusted in their field, numbers are right-adjusted. Strings are not encased in quotes. Lines are fixed width, and columns are apparent when viewing the file. Field widths are as follows: title is 80 characters; parameter names and units are 8 characters each; numbers are 8 digits including the radix separator and decimal digits; formatted dates are two 8 character strings separated by 1 space; separated dates are six 3-digit values; combined dates are an 8-digit number and an 8 character string separated by 1 space; Julian dates are 10 digits; numeric dates are 13 digits; relative dates are 9 digits.

Example: 12/31/92 23:59:59 123.45 12.3 123

Default scaling technique: Automatic
Default parameters per plot: 2

Select these options to modify the default values for reports and plots. These options are described in detail in the MODIFY portion of Section 5.4. The Setup menu determines what the default scaling technique and parameters per plot should be for each new data file. To modify these options for all future reports and plots change the values here. To modify these options only for a current file, see Section 5.4.

6. PRINCIPLES OF OPERATION

6.1 CONDUCTIVITY

The 6000UPG utilizes 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 milliSiemens per cm (mS/cm), the conductance is multiplied by the cell constant which has units of reciprocal cm (cm^{-1}). The cell constant for the 6000UPG 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; see Section 3.2. 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 6000UPG software also allows the user to output conductivity data in either raw or temperature compensated form. If Conductivity is selected, values of conductivity which are *NOT* compensated for temperature are output to the report. If Specific Conductance is selected, the 6000UPG 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):

$$\text{Specific Conductance (25 C)} = \frac{\text{Conductivity}}{1 + TC * (T - 25)}$$

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 (approximately 500 mL).

(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.

6.2 SALINITY

Salinity is determined automatically from the 6000UPG conductivity 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 which 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.

6.3 OXIDATION REDUCTION POTENTIAL (ORP)

The 6000UPG determines 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 the 6000UPG, a combination an ORP probe must be in place in the ISE2 port of the sonde bulkhead and ORP must be activated in both the sensor and report setups. The ORP sensor consists of a platinum ring found on the tip of the probe. The potential associated with this metal is read versus the Ag/AgCl reference electrode of the pHsensor in the ISE1port Thus, to read ORP you must also have a pH probe installed. ORP values are presented in millivolts and are not compensated for temperature.

CALIBRATION AND EFFECT OF TEMPERATURE

Calibration is required infrequently for the ORP sensor of the 6000UPG. However, after long term use of the pH and ORP probes some deviation from the theoretical ORP value may occur. This deviation is usually due to a change in the concentration of the KCl in the reference electrode gel and can be "calibrated out" using the sonde software involving ORP calibration. However, the

deviation may also be due to fouling of the platinum ORP sensor. This problem can usually be corrected by cleaning the platinum ring according to the manufacturer's instructions.

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 210-250 mv at normal ambient temperature. If the reading is outside of this range, the probe should be cleaned, rechecked, and then can be calibrated to the correct value (231 mV at 25°C) using the calibration procedure outlined in Section 4.2.

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	263.5
5	257
10	250.5
15	244
20	237.5
25	231
30	224.5
35	218
40	211.5
45	205
50	198.5

MEASUREMENT AND CALIBRATION PRECAUTIONS

(1) Instructions for preparation of ORP calibrator solutions can be found in Section 2580 A. of *Standard Methods for the Examination of Water and Wastewater.* Alternatively, the reagent is available from YSI.

(2) 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.

(3) Clean and store the pH/ORP sensor following the instructions in Section 7 and Appendix G of this manual.

6.4 pH

The 6000UPG employs 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 which utilizes gelled electrolyte. 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 6031 pH sensor currently-available for the 6000UPG should provide long life, good response time, and accurate readings in most environmental waters, and tests have shown that it functions well in water of very low conductivity as well as higher conductivity media. However, YSI is continually testing pH sensors for improved performance and ruggedness and in the future may offer additional sensors which are more specific for various types of water.

CALIBRATION AND EFFECT OF TEMPERATURE

The software of the 6000UPG 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 6000UPG 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 6000UPG 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 6000UPG 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 pH probe and temperature sensor of the 6030 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 found in instructions found in Section 7 and Appendix G of this manual.

6.5 DEPTH

The 6000UPG measures depth via a factory installed strain gauge sensor. The voltage output of this device is directly proportional to the hydrostatic pressure exerted by the column of water over the sonde. The 6000UPG software converts this voltage to a depth reading in feet or meters via calibration parameters which are factory installed. Readings are automatically compensated for the density of the environmental medium which is estimated from the measured salinity.

CALIBRATION AND EFFECT OF TEMPERATURE

The depth sensor must be zeroed prior to deployment to account for atmospheric pressure. This procedure is carried out by following the calibration menu instructions with the sonde in air only (do not submerge). 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.

(2) Remember that the sensor which is currently available for the 6000UPG is not vented. In practical terms, this means that changes in barometric pressure after the sensor is initially 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 ft (0.012 m).

6.6 TEMPERATURE

The 6000UPG utilizes a thermistor of sintered metallic oxide which changes predictably in resistance with temperature variation. The algorithm for conversion of resistance to temperature is built in to the 6000UPG software, and accurate temperature readings in degrees Celsius, Kelvin, or Fahrenheit are provided automatically. No calibration or maintenance of the temperature sensor is required.

6.7 DISSOLVED OXYGEN

The 6000UPG employs 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 severely limit the length of a remote deployment unless an external battery source is utilized) 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 associated with the 6000UPG since it needs no stirring to yield accurate readings for either spot sampling or deployment applications. The 6000UPG can accurately monitor DO for up to 90 days using only the eight C-cells enclosed in the sonde.   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 which is not radically different from 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 6030 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 (which diffuses through the Teflon membrane) to be reduced to hydroxide ion at the cathode and silver metal to be oxidized to silver chloride at the anode. 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 6000UPG Rapid Pulse system is calibrated using the same basic methods employed for steady state oxygen sensors.

The two general calibration methods possible with the 6000UPG 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 by well-known algorithms, calibration by either method results in correct outputs in both units.

If the mg/L method is selected from the 6000UPG **Calibrate** menu, the oxygen concentration of an aqueous solution may be determined by several methods:

1.) Winkler titration
2.) Aerating the solution and assuming that it is saturated, or
3.) Measurement with another instrument.

If this calibration method is employed, place the sonde into this known-value solution and input the value (in mg/l) into the 6000UPG software after the reading has stabilized and then, after the reading has stabilized (2-5 minutes).

If the Percent Saturation method is selected, the sonde is simply placed in a calibration cup which contains a small quantity of water or a damp sponge. *The probe sensor should not be in the water for this calibration procedure*. After time has been allowed for equilibration of the temperatures of the thermistor and the DO probe (10-15 minutes), the barometric pressure is entered into the 6000UPG software, and the calibration procedure is begun. Once the actual calibration protocol has been initiated, the Rapid Pulse system will apply several warm-up pulses to the probe and then read the last pulse as the calibration parameter. The number of warm-up pulses is determined by the probe stability and user setup. Thus, the procedure takes a minimum of approximately 44 seconds, depending on the warm-up time which the user has chosen. This warm-up/read sequence is used in all Unattended Sampling determinations of dissolved oxygen using the 6000UPG.

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. This compensation is automatically carried out by the sonde software.

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. Both of these temperature related factors are compensated for by the 6000UPG software 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 F 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 60 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) Keep the probe moist when not in use, either by immersing in water or by placing a damp sponge in the calibration vessel. If the membrane appears to be damaged or has dried out, be sure to replace it prior to calibration and deployment.

(4) If possible, calibrate the Rapid Pulse system at a temperature as close as possible to that of the sample being measured. If possible, immerse the calibration chamber (which contains either a small amount of water or a wet sponge) into the body of water which 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.

(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.

6.8 NITRATE

The 6000UPG nitrate probe consists of a sealed module containing of a silver/silver chloride wire electrode immersed 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 which depends on the relative amounts of nitrate in the sample and the internal filling solution (which is invariant). This potential is read relative to the Ag/AgCl reference electrode of the 6000UPG 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 empirically 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 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. 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 which 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 an interference so great as to make the sensor unsuitable for these media.

Despite the potential problems with interferences when using ISEs, it is important to remember that almost all interfering species produce an artificially high nitrate reading. Thus, if the 6000UPG 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 6000UPG. 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 6000UPG, 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 3.2 and 4.2. 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 which 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 one of your standards at the end of each deployment.

(4) Nitrogen standards are good growth media for a variety of organisms. This growth can significantly reduce the nitrogen content of your standards - an effect which 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*.

6.9 AMMONIUM AND AMMONIA

The 6000UPG ammonium probe employs a sealed module containing a silver/silver chloride (Ag/AgCl) wire electrode immersed 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 which depends on the relative amounts of ammonium in the sample and the internal filling solution (which is invariant). This potential is read relative to the reference electrode of the 6000UPG 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 interferences 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 all of that ionic content were due to sodium chloride, the ammonium reading would be erroneously high by about 0.4 mg/L.

However, brackish or sea water has enough sodium and potassium to cause interferences so great as to make the sensor unsuitable for these media.

The sensor used in the 6000UPG 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 6000UPG 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:

$$NH_4^+ \rightleftharpoons NH_3 \ + \ H^+$$
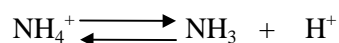
The value of the equilibrium constant associated with this reaction, $K = [NH_3][H^+]/[NH_4^+]$, and its variation with temperature and salinity, is well known. This information allows the free ammonia concentration [NH_3] to be automatically calculated by the 6000UPG sonde software and displayed if this parameter is activated.

Despite the potential problems with interferences when using ISEs, it is important to remember that almost all interfering species produce an artificially high ammonium reading. Thus, if the 6000UPG 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.

Ion selective electrodes have the greatest tendency to exhibit calibration drift over time of all the sensors available on the 6000UPG. 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 6000UPG, 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 3.2 and 4.2. 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 which 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 one of your standards at the end of each deployment.

(4) Nitrogen standards are good growth media for a variety of organisms. This growth can significantly reduce the nitrogen content of your standards, an effect which 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.*

6.10 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 6000UPG consists of a probe which conforms to the above ISO recommendations and an interface printed circuit board which must be factory installed within the 6000UPG sonde. The output of 6000UPG turbidity sensor is processed via the sonde software to provide readings in nephelometric turbidity units (NTUs).

If the option is installed, the 6000UPG can easily measure turbidity in short term sampling applications, but it has also been designed with long term deployments in mind. Optical measurements are particularly susceptible to fouling, not only from long term build up of biological debris, but also to shorter term formation of bubbles from outgassing of the environmental water. For this reason, the 6000UPG turbidity probe is equipped with a mechanical wiper which rotates on the probe face, keeping the optics as free as possible from bubbles and fouling build-up. The wiper can be activated in real-time during discrete sampling and calibration operations or will function automatically during long term unattended sampling studies. The number of wiper movements for the unattended mode can be set up in the sonde software. Generally one rotation is sufficient, but in media with particularly heavy fouling, additional cleaning will be required even though battery life will be reduced.

CALIBRATION AND EFFECT OF TEMPERATURE

The 6000UPG 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 made 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. The 1 point calibration must be done at 0 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. The bubbles can be cleaned from the surface by activating the wiper prior to each calibration input or by manually moving the sonde (up/down and back/forth)

(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 very uniform.

The 6000UPG turbidity system allows the user to either observe these real turbidity events (while obtaining somewhat jumpy readings) or to average several readings to obtain an NTU output which may be more reflective of the overall cloudiness of the environmental sample. The user can select the number of samples to average on activation of the turbidity sensor in the Sensor Setup portion of the sonde menu. If the user selects 8 at the **Number of Samples to Average** prompt, the 6000UPG will calculate an 8 point, continuous running average of turbidity readings in Discrete sample mode. This data processing will have an adverse effect on the response time of the sensor, but for sampling applications, this is usually a minor inconvenience since many of the other sensors take a least 1 minute to completely stabilize. The advantage of the data processing is a much more stable sequence of turbidity readings output to the screen.

For unattended sampling applications, selection of 8 at the **Number of Samples to Average** prompt results in a somewhat different data processing sequence. In this case, the 6000UPG will take 8 turbidity readings 4 seconds apart at the time the unit wakes up to record a reading. The software will calculate a simple average of these 8 readings and log this value to memory when the final measurement of all parameters is complete. The disadvantage of this approach is that the turbidity sensor will be activated for a longer interval during deployments and this, in turn, will result in a shorter battery life. However, as for the discrete sample treatment, the advantage of the data processing is a much more stable sequence of logged turbidity readings which are likely to better reflect the overall cloudiness of the water being monitored.

Experience will allow the user to be better able to determine whether any averaging sequence is appropriate for the particular sample in question, and, if so, how many samples to average for the output or logged values.

See Appendix H for additional practical information on the measurement of turbidity with the 6000UPG.

7. MAINTENANCE

A Model 6040 Maintenance Kit is available for use with the 6000UPG. The kit includes several items which will be helpful or necessary in performing the proper routine maintenance on the 6000UPG.

The 6040 Maintenance Kit includes a variety of O-rings, a hex driver, replacement hex cap screws, 2 cleaning brushes, O-ring lubricant, and 2 replacement pressure caps for sealing the sonde cable connector.

The Model 6040 Maintenance Kit can be ordered from any authorized YSI dealer, or directly from YSI. See Appendix C for details.

7.1 SONDE MAINTENANCE

When caring for the 6000UPG sonde, it is important to 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, to do so would void the manufacturer's warranty.

SONDE AND SENSOR 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 our 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.   We have now summarized these storage recommendations in a separate document which is included in this manual as Appendix G.

These current storage guidelines are, in some cases, slightly different from those provided in our previous manuals on the YSI Models 6000UPG, 600, and 600XL. We believe that the previous storage recommendations were good, but that the procedures described in the current version are better.   No doubt these recommendations will continue to be refined slightly as we introduce new sensors and gain additional information from testing. Please refer to Appendix G for detailed instructions for sensor storage. Note that the appendix deals with instruments other than the 6000UPG, so be sure to refer specifically to the instructions for the instrument which you have purchased.

Proper storage of the 6000UPG 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

BATTERY CHAMBER

When changing batteries, always check the inside of the battery chamber to assure that no water has seeped into the chamber. If the chamber has become wet, dry the chamber thoroughly with compressed air, a clean cloth, or paper towels.

Dry and clean the battery chamber lid with a clean cloth. Before reinstalling the lid, place a very thin coat of O-ring lubricant on the lid O-ring.

NOTE: If you remove the battery lid with the sonde in a horizontal position, moisture will *not* be able to run into the battery compartment.
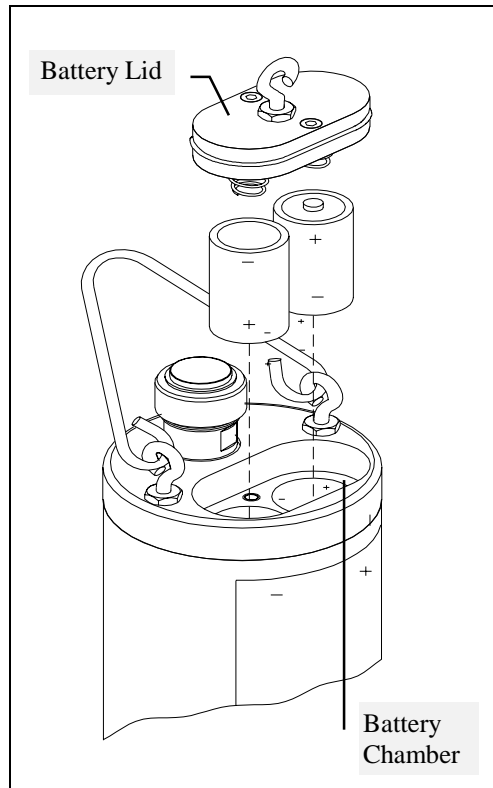
SONDE PROBE PORTS

Whenever a probe is installed, removed, or replaced, it is extremely important that the entire sonde and all probes be thoroughly dried prior to the removal of the probe or the probe port plug. This will prevent water from entering the port. Once the probe or plug has been removed, 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's Product Service Department (see Appendix C for details). When reinstalling a probe or port plug, lightly grease the O-ring with lubricant supplied in the 6040 Maintenance Kit.
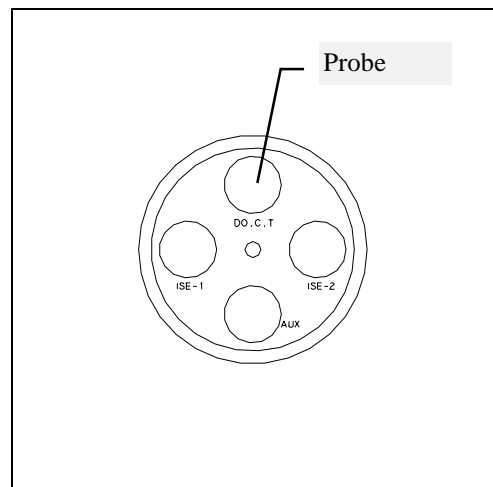
CABLE CONNECTOR PORT

The cable connector port at the top of the sonde should be covered at all times. While communicating with the sonde, the installed cable should be securely tightened in place. By so doing, it is assured that a proper connection is being made and moisture and possible contaminants are prevented 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. Two replacement caps are available in the 6040 Maintenance Kit.

If moisture has entered the connector, dry the connector completely with compressed air, a clean cloth, or paper towel. Apply a very thin coat of lubricant from the 6040 Maintenance Kit to the O-ring inside the connector cap before each installation.

Cable
Connector
Port
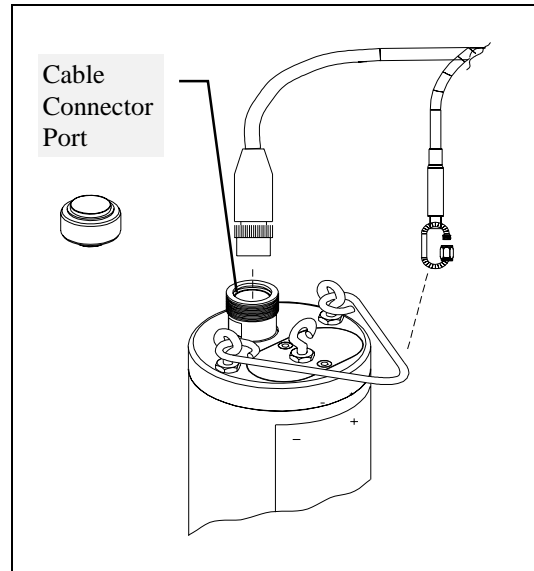
NOTE: ALWAYS BE CERTAIN THAT THE CONNECTOR CAP IS CORRECTLY INSTALLED BEFORE SUBMERGING THE SONDE.

SONDE HEX SCREWS

Prior to each deployment of the sonde, inspect the hex screws to assure that all ten screws are in place and properly tightened. In the event that a screw is lost, replacement screws can be found in the 6040 Maintenance Kit.

7.2 PROBE MAINTENANCE

Once the probes have been properly installed, regular cleaning and oxygen probe membrane changes are required.

6029 COND/TEMP & 6030 DO/COND/TEMP PROBES

For best results, it is recommended that the KCl solution and the Teflon membrane at the tip of the 6030 probe be changed prior to each sonde deployment. See Section 2.2.

After removing the used membrane from the tip of the 6030 probe, examine the electrodes at the tip of the probe.
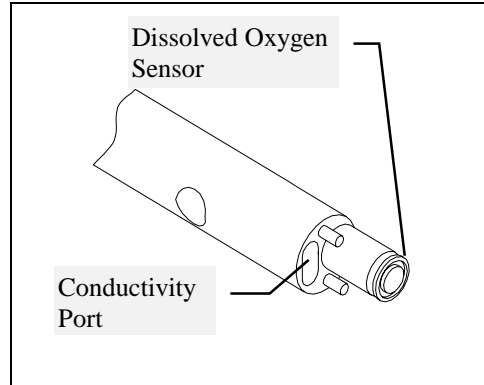
If either or both of the silver electrodes are black in color, the probe should be resurfaced using the

sanding disks which are provided in the 6035 reconditioning kit. Following the instructions supplied with the kit, 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 parallel direction to the gold electrode. The motion is similar to that used in striking a match. Usually 10-15 strokes of the sanding disk is sufficient to remove black deposits on the silver electrodes, but, in extreme cases, more sanding may be required to regenerate the original silver surface.
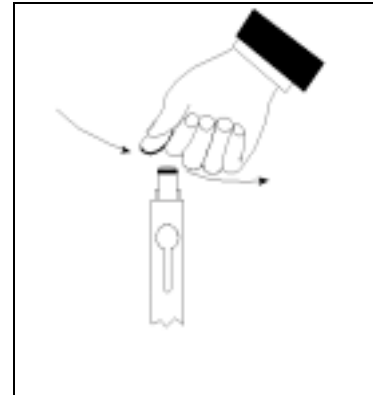
After the sanding procedure is complete, repeatedly rinse the probe face with clean water and wipe with lens cleaning tissue to remove any grit left by the sanding disk.   After cleaning, thoroughly rinse the entire tip of the probe with distilled or deionized water and install a new membrane. See Section 2.2.

CAUTION: Be sure to: (1) Use *only* the 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 dealer service center. See Appendix C for contact information.

CONDUCTIVITY

The openings which allow fluid access to the conductivity electrodes must also be cleaned regularly. The small cleaning brush included in the 6040 Maintenance Kit is ideal for this purpose. Dip the brush in clean water and insert it into each hole repeatedly 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. Avoid getting detergents on the dissolved oxygen portion of the probe. 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 Appendix C for contact information.

TEMPERATURE

The temperature portion of the probe requires no maintenance.

6031 pH, 6032 ORP and 6033 LOW IONIC STRENGTH pH PROBES

Cleaning is required whenever deposits or contaminants appear on these glass probes. Remove the probe from the sonde. Next, remove the probe from its protective guard. Use clean water and a clean cloth to remove all foreign material from the glass probe. Then gently remove any contamination from the pH glass sensor bulb or the ORP sensor platinum ring using moist lens cleaning tissue. Finally, carefully remove any material which may be blocking the reference electrode junction of the pH sensor. However, be certain that you do not insert any objects into the small reference electrode junction holes.

Protective Guard

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.
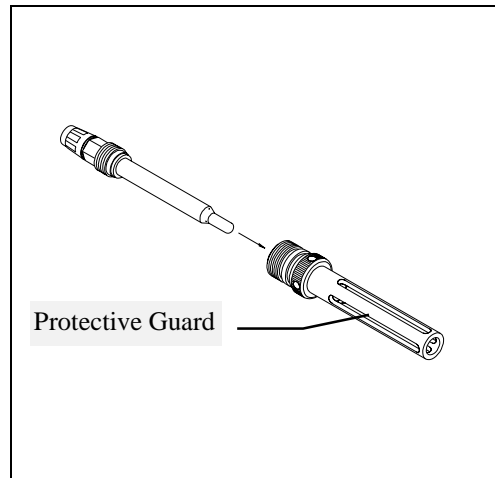
DEPTH SENSORS

The depth sensors are factory installed options which are located inside the sonde body. There is a small plastic fitting which protects the threads of the depth probe port. Before each sonde deployment, inspect this plastic fitting and clear any obstruction which may have clogged it. In the event that the plastic hose fitting is damaged or missing, a replacement can be found in the 6040 Maintenance Kit.

NOTE: Never try to remove an obstruction to the plastic fitting while it is installed in the sonde probe plate. To do so would risk damage to the depth sensor.

If the 6000UPG you are using does not contain the depth or level option, the depth port will be fitted with a small brass plug.

Brass Plug

Plastic
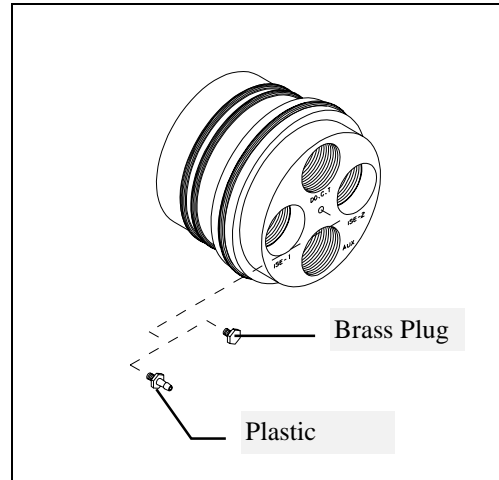
6083 NITRATE AND 6084 AMMONIUM PROBES

Cleaning is required whenever deposits or contaminants appear on the ion selective membranes located on the tips of these probes. Following the diagram above for pH and ORP sensors, remove the probe from the sonde. Next, remove the probe from its protective guard. Use clean water and a moist piece of lens cleaning tissue to *gently* wipe the sensor membranes until no more contaminates are removed. After cleaning is complete, 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.
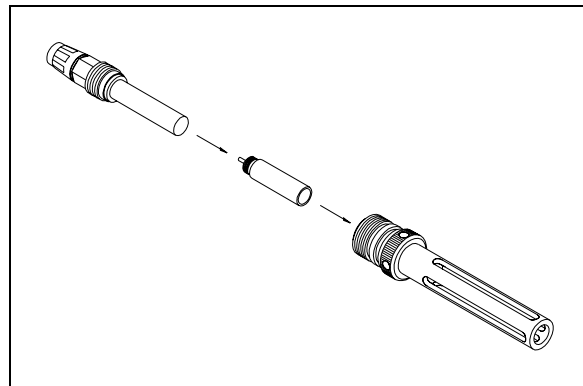
NOTE: The ion selective membranes are fragile. Be certain to: (1) Use only *moist*, high quality lens cleaning tissue for the cleaning procedure (not paper towels or other coarse materials); and (2) Stroke the probe face very gently with the tissue during the procedure. *Not adhering to either of these instructions can seriously damage the sensors.*

6026 TURBIDITY PROBE

The 6000UPG turbidity probe requires 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,
it is recommended that the wiper be replaced
periodically. The frequency of this replacement
depends on the quality of water under
examination. A replacement wiper is supplied
with the 6026 sensor, along with the hex driver
required for its removal and reinstallation.
Follow the instructions supplied with the turbidity sensor to insure proper installation of the new
wiper assembly. Additional wipers are available from YSI.
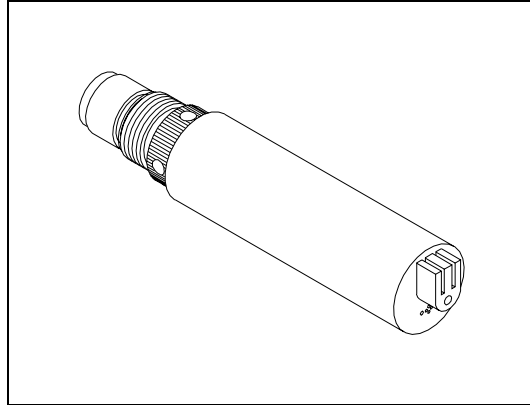
NOTE: If any of the 6000UPG probes are removed from the sonde for maintenance, dry the sonde
port and probe connector with compressed air and apply a very thin coat of O-ring lubricant to all
O-rings before re-installation.

7.3 GENERAL MAINTENANCE NOTE

In the event that the 6000UPG continues to exhibit some problem that you can not correct by
following the Maintenance procedures outlined within this section, call your authorized service
center. See Appendix C for contact information.

> **CAUTION: DO NOT ATTEMPT TO GAIN ACCESS TO THE INTERNAL CIRCUITRY
> OF THE SONDE.**

8. TROUBLESHOOTING

The following tables should be helpful in identifying the cause of the most common difficulties which may occur while operating the 6000UPG. The column titled **Symptom** details the type of difficulty you might experience. The column titled **Possible cause** details the conditions which might cause the stated symptom. The column titled **Action** provides simple steps which can be followed to correct for the "possible cause" and cure the "symptom" being experienced. The column titled **Ref** is the reference section and subsection in the manual where you may find additional information.

Symptoms have been categorized into four general areas.
- Communication
- Sensor Performance
- Software
- System Error and Warning Messages

System Error and Warning messages are detailed in Appendix I of this manual. Therefore you will find only three identified tables in this section.

If you need assistance for which the following tables are not immediately helpful, please contact YSI customer service.   See Appendix C for specific contact information.

COMMUNICATION PROBLEMS

SYMPTOM	POSSIBLE CAUSE	ACTION	REF
Can not communicate with sonde	Comm port not properly selected	Change comm port	5.5
	Cable connection is loose	Check both ends of cable; secure connectors	
	Sonde batteries are depleted	Change batteries	7.1
	Water in battery compartment	Dry compartment	7.1
	Internal failure	Return sonde for service	C
Scrambled data	Unmatched baud rate between host and sonde	Match the baud rate	2.4 4.5
	Host is too slow	Use faster computer or different software	
	Interface cable failure	Check cable for damage. If necessary, return for service	
	Internal failure	Return sonde for service	C
Unable to upload data from sonde to PC	Insufficient PC disk space	Make space or specify different drive	5.7
	Communication problem	See communication sections above	
	Internal failure	Return sonde for service	C

SENSOR PERFORMANCE PROBLEMS

SYMPTOMS	POSSIBLE CAUSE	ACTION	REF
Oxygen unstable or inaccurate	Probe not properly calibrated	Follow DO cal procedures	3.1
	Membrane not properly installed or may be punctured	Follow 6030 setup procedure	2.2
	DO probe electrodes require cleaning	Follow DO cleaning procedure	7.2
	Water in probe connector	Dry connector; reinstall probe	2.2
	Algae or other contaminant clinging to DO probe	Rinse DO probe with clean water	
	Barometric pressure entry is incorrect	Repeat DO cal procedure	3.1
	Cal at extreme temperature	Recal at (or near) sample temperature	
	DO Charge too high	Follow DO cleaning procedure	7.2
	DO probe has been damaged	Replace 6030 probe	2.2
	Internal failure	Return sonde for service	C

SENSOR PERFORMANCE PROBLEMS continued...

SYMPTOM	POSSIBLE CAUSE	ACTION	REF
pH, ORP, Ammonium, or Nitrate unstable or inaccurate. Error messages appear during calibration.	Probe requires cleaning	Follow probe cleaning procedure	7.2
	Probe requires calibration	Follow cal procedures	3.1
	Probe has been damaged	Replace pH or ORP probe. Replace sensor module on ammonium or nitrate sensors.	E
	Water in probe connector	Dry connector; reinstall probe	E
	Calibration solutions out of spec	Use new calibration solutions	
	ORP fails Zobell check	Repeat test. Check possible causes above.	6.3
	Internal failure	Return sonde for service	C
Depth unstable or inaccurate	Depth sensor has not been zeroed	Follow depth zero procedure	3.1
	Depth sensor access hole is obstructed	Follow depth cleaning procedure	7.2
	Depth sensor has been damaged	Return sonde for service	C
	Internal failure	Return sonde for service	C
Conductivity unstable or inaccurate. Error messages appear during calibration.	Conductivity improperly calibrated	Follow cal procedure	3.1
	Conductivity probe requires cleaning	Follow cleaning procedure	7.2
	Water in probe connector	Dry connector; reinstall probe	2.2
	Conductivity probe damaged	Replace 6030 probe	2.2
	Calibration solution out of spec	Use new calibration solution	3.2
	Calibration value too far from sample value	Cal at or near expected value	3.2
	Internal failure	Return sonde for service	C
	Calibration solution or sample does not cover entire sensor.	Immerse sensor fully.	3.1
Installed probe has no reading	The sensor has been disabled	Enable sensor	4.7
	Water in probe connector	Dry connector; reinstall probe	2.2
	Probe has been damaged	Replace the probe	2.2
	Report output improperly set up	Set up report output	4.6
	Sonde's autodetect feature has malfunctioned	Return sonde for service	C
	Internal failure	Return sonde for service.	C

SENSOR PERFORMANCE PROBLEMS continued...

"High DO Charge" message during DO cal	DO sensor needs reconditioned	Recondition sensor. Use 6035 Kit	7.2
Tubidity probe unstable or inaccurate. Error messages appear during calibration	Probe requires cleaning.	Follow probe cleaning procedure	7.2
	Probe requires calibration	Follow cal procedures	4.2
	Probe has been damaged	Replace probe	E
	Water in probe connector	Dry connector; reinstall probe	E
	Calibration solutions out of spec	Use new calibration solutions	
	Wiper is not turning or is not synchronized.	Activate wiper. Assure rotation. Make sure set screw is tight.	7.4
	Wiper is fouled or damaged.	Clean or replace wiper.	7.4
	Internal failure.	Return sonde for service.	C

SOFTWARE PROBLEMS

SYMPTOMS	POSSIBLE CAUSE	ACTIONS	REF
Unable to setup a sensor or setup date and time	The sonde is in unattended sample mode	Cancel unattended sample mode	3.4
	There is an open file	Close any open files	4.1
	Internal failure	Return sonde for service	C
Missing data within an unattended sample	Study not setup correctly	Follow instruction	3.4
	Date and time is incorrect	Reset date and time	2.5
	Upload takes priority over sample	Data lost. No corrective action.	
	Internal failure	Return sonde for service	C
Uploaded file is not found in file directory	Site description of study has not been defined	Check for filename "undefined"	
	Data directory is specified elsewhere	Check advanced setup for data directory	5.7
	Insufficient PC disk space	Make space or specify a different drive	5.7
Upload unsuccessful	Insufficient PC disk space	Make space or specify a different drive	5.7
	Low battery voltage	Replace batteries	7.1

SYMPTOMS	POSSIBLE CAUSE	ACTIONS	REF
	Communication noise	Try lower baud rate	2.4 4.5
	Internal failure	Send sonde for service	C
Expected parameters are not displayed on reports or plots	Parameters not added to Y-axis list	Add parameter	5.4
	Sensor disabled or not detected	Check sensor setup instructions	4.7
Unable to print reports or plots	Printer port improperly set	Check setup	5.7
	Printer type improperly selected	Check setup	5.7
	Print cable improperly connected	Check connections at both ends	
Video screen of PC is not readable	Incorrect menu color option has been selected	Select appropriate menu parameter	2.4
	Incorrect graphic mode	Select compatible graphic mode	5.5
When selecting "sonde" from PC6000 top line, sonde menu not shown	Prompt # appears in place of menu	Type "menu" and press (enter)	
	Communication problem	See communication above	
Premature termination of unattended sampling	Full flash disk	Upload all data and format flash disk	4.3
	Internal failure	Return sonde for service	C

9. COMMUNICATION

This section describes the communications protocol that the 6000UPG uses to communicate with the host system.   Section 1 gives a brief overview of the communication ability of the 6000UPG. The remaining sections describe available hardware and software features.

9.1 OVERVIEW

The 6000UPG communicates via a serial port that can be configured as either SDI-12 or as a 3 wire RS-232 interface. The serial port supports the following configurations:

Baud rate: 300, 600, 1200, 2400, 4800, 9600, 19200
Data Bit: 7,8
Parity: None
Handshake: XON/XOFF
Interface: RS-232, SDI-12, Modem
Default: RS-232

With these configurations, the 6000UPG is capable of interfacing to a variety of devices from a "dumb" terminal to numerous data collection platforms.

With the built-in non-volatile memory, the 6000UPG can store from several weeks to several months of data depending on the logging interval. Data can be retrieved using the ASCII or the more sophisticated Kermit file transfer protocol (FTP). The advantage of the Kermit FTP is its capability for error detection and retransmitting.

9.2 HARDWARE INTERFACE

Connection from the Model 6000UPG to the host computer is provided using the YSI 6095 MS-8 to DB-9 female adapter. This 6095 then connects to the standard DB-9 male connector on the host computer. The Model 6000UPG 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 Model 6000UPG with the 6095 adapter.

Wire Color	Pin Description	DB-9	MS-4	MS-8
Yellow	RS232 TX	2	----	C
Orange	RS232 RX	3	----	D
Green	Alarm	----	----	E
Gray	RTS	----	----	G
Blue	CTS	----	----	H
Red	+ 12V DC	9	A	A
Black	GND	5	C	B
Purple	SDI-12	----	B	F
Bare	Shield	----	----	B

Signal	Dir	Function	COLOR
Shield		Shield ground	BARE
SDIDAT	I/O	SDI-12 data	PURPLE
TX	OUT	RS-232 Transmit data	YELLOW
SGND	-	RS-232 signal ground	GREEN
RX	IN	RS-232 Receive data	ORANGE
PWR	IN	SDI-12 power	RED
PGND	-	SDI-12 ground	BLACK

9.3 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 6000UPG 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. As many as 10 sensors can be connected to the bus at a time. Each sensor is preassigned a unique address from 0 to 9. Each 6000UPG is factory set to address 0. The address can be changed in the System Setup menu (see Section 4.5). The 6000UPG implements the basic SDI-12 command set. Below are the descriptions of each command and their responses. At the end of this section, you will find the 6000UPG commands that are used to run and troubleshoot SDI-12.

The following notations are used:

- **a**   6000UPG 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.

6000UPG:        atttn[CR][LF]
```

ttt - Maximum time in seconds the 6000UPG 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-setup menus (see Section 4.6).   Date and time are also counted. If the number of parameter set is greater than 9, it is truncated to 9.

After finishing the measurement, the 6000UPG will 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 6000UPG does not send a service request within the specified maximum time, the measurement was canceled. The bus master can then send a "V" command (see below) to obtain the specific error code or restart with another "M" command.

```
Master:         aV!              Initiate a verifying sequence.

6000UPG:        atttn[CR][LF]
```

ttt - The time the 6000UPG will take to execute the verifying sequence. This is always 004 seconds.

n - Number of data from the verifying sequence. This is always 5.   The 5 data that will be available are date, time, battery voltage, free flash disk space in KB, and the last system error code (in this order).

After finishing the verifying sequence, the 6000UPG will send a service request "a[CR][LF]" to the bus master. The bus master can then retrieve all verifying data with a single "D0" command (see below).

```
Master: aI!              Send identification.

6000UPG:        allccccccccmmmmmmvvvxxx...xxx[CR][LF]
```

l - 2 character SDI-12 level number. For version 1.00 of the EMS6000 software, this field is "10".

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 "EM6000" (Environmental Monitoring System 6000UPG).

v - 3 character version number. This field holds the EMS6000 software version number ("100" for version 1.00).

x - 0 to 13 characters identify active measurement parameters. These parameters are available through "D0" to "D9" commands followed by an "M" command. Each parameter is coded as a single character as follows.

'1'- Date
'2'- Time
'3'- Temperature
'4'- Specific conductance
'5'- Conductivity
'6'- Resistivity
'7'- Total dissolved solid (TDS)
'8'- Salinity
'9'- DO %
'A'- DO mg/L
'B'- ISE1
'C'- ISE2
'D'- Depth
'E'- Battery voltage
'H'- Turbidity

Master: aD0! to aD9!   Retrieve measurement/verifying data

6000UPG: 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. The time and date fields will not carry any separator. They always start with a positive sign '+' followed by 6 digits (pre-filled with 0 if required). The order of date, month, and year depends on the current date format which can be set in the System-setup menu (see Section 4.5).

If the number of values returned by the "D0" command is less than the number specified in the previous response to "M" or "V" 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" or "V" command, it will return the same data. If the response to the "D0" command is "a[CR][LF]" then either no "M" or "V" command was received before the first "D" command or the "M" or "V" command was canceled.

Example: Assume that the date format is MM/DD/YY.   The radix mark is set to period '.'.   The report output is set to report Date, Time, Temperature, Specific conductance, DO %, DO mg/L, pH

(ISE1), ORP (ISE2), and Depth (in this order).   The DO warm-up time is set to 40 seconds.
Finally, the 6000UPG SDI-12 address is set to 1.

Master: 1V!

6000UPG: 10045[CR][LF]

The bus master initiates a verifying sequence. The 6000UPG responds that it will take a maximum
of 4 seconds to perform this command and, upon completion, it will have 5 data available.
... (after about 3 seconds)...

6000UPG: 1[CR][LF]

Master: 1D0!

6000UPG: 1+071592+094515+10.5+183+0[CR][LF]

When the 6000UPG finished the verifying sequence, it sent a service request to the bus master. The
bus master proceeded to retrieve the data with a "D0" command. The returned data showed that the
6000UPG real time clock read July 15, 1992 at 9:45:15. The battery voltage is 10.5 volts. The free
disk space is 183 KB. And there was no error.

Master: 1I!

6000UPG: 110YSIIWQSGEM600010012349ABCD[CR][LF]

The bus master asked for identification and the 6000UPG returned data showing the following.

         SDI-12 level: 1.0
         Manufacturer: YSIIWQSG
         Model: EM6000
         Version: 1.00
         Sensor output: Date, Time, Temperature, Specific conductance, DO %, DO mg/L,
                         ISE1, ISE2, Depth

Master: 1M!

6000UPG: 10489[CR][LF]

The bus master sent a measurement command. The 6000UPG will take a maximum of 48 seconds to
finish the measurement. Upon completion, it will have 9 sensor data available.
...(after about 46 seconds)...

6000UPG: a[CR][LF]

Master: 1D0!

6000UPG: 1+071592+101500+17.5+12.05+98.7[CR][LF]

Master: 1D1!

6000UPG: 1+8.25+6.45-325+10[CR][LF]

After finishing the measurement, the 6000UPG 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 9 readings should be available, the master continued with "D1" commands and received the remaining data.

Master: 1D1!

6000UPG: 1+8.25+6.45-325+10

For some reason, the bus master received scrambled data with the previous "D1" command. It reissued the command to get the correct data. The responses from "D0" and "D1" commands are

Date:	07/15/92
Time:	10:15:00
Temperature:	17.5
Specific conductance:	2.05
DO %:	98.7
DO mg/L:	8.25
pH (ISE1):	6.45
ORP (ISE2):	-325
Depth:	10

RUNNING SDI-12:

Four commands are available to run and troubleshoot SDI-12. These commands are entered from the command line, at the '#' prompt. Following are the descriptions of each command.

SDIADDR [a]

Set the 6000UPG SDI-12 address to 'a'. The address 'a' is from 0 to 9. If 'a' is greater than 9, the address remains unchanged. If 'a' is not specified, the 6000UPG will display the current SDI-12 address.

SDI12

This command activates SDI-12 mode. This is the only mode that the 6000UPG will respond to any SDI-12 command. To exit to command line, hit any key from the terminal connected to the RS-232 port. The 6000UPG provides a confirmation before exiting. If there is no response within 5 seconds, the 6000UPG will return to SDI-12 mode.

9.4 RS-232 INTERFACE

The RS-232 interface is provided through the standard DB25 female connector. The 6000UPG supports XON/XOFF handshaking. The XON/XOFF handshake uses the standard ^S character (ASCII 19) for XOFF and ^Q character (ASCII 17) for XON. To prevent permanent XOFF that could keep the 6000UPG awake indefinitely and triple the power consumption, a 1 minute timer is used to timeout the XOFF. If an XOFF is received for at least 1 minute without XON, the timer will activate and clear all pending data from the transmitter queue and reset the queue.

9.5 FILE TRANSFER PROTOCOLS

In all three modes of operation, the 6000UPG can log data to its internal non-volatile memory (Flash disk). As many as 130000 basic sensor readings can be saved in the Flash disk at a time. To retrieve this large amount of data, two file transfer protocols are provided: ASCII and Kermit.

ASCII protocol transfers all calculated readings (basic and derived sensors) in plain ASCII. A pair of [CR][LF], in that order, is sent at the end of each line. No error detection is employed. The transfer is initiated from the 6000UPG command line. The 6000UPG then waits for any character from the host before it begins the transfer. If no signal is detected within a preset amount of time, it will proceed with the transfer.

Kermit FTP breaks data into several small packets. Each packet requires a positive acknowledgment before the next packet can be sent.   A CRC check is performed on each packet and request for resend is issued if an error is detected. For the limited memory space available, the 6000UPG only implements basic Kermit FTP. It does not support batch file transfer, data compression, or most extended Kermit specifications. It does, however, support extended packet lengths for increased upload efficiency. For more information on Kermit, refer to a book by Frank da Cruz entitled, *Kermit A File Transfer Protocol*, Digital Press, Massachusetts, 1987. Or write to:

  Kermit Distribution
  Columbia University Center for Computing Activities
  612 West 115th Street
  New York, NY 10025
  USA

9.6 FILE FORMATS

The 6000UPG supports three file formats: PC6000, comma and " " delimited (CDF), and ASCII text.

The PC6000 format file is in binary. It contains only basic sensor readings. All readings are in 32-bit IEEE floating point format. For each data, the least significant byte comes first. This file takes the least amount of processing time and has the smallest size. The PC6000 software bundled with the 6000UPG can be used to process the file. All calculated sensor readings such as salinity, DO concentration, etc. are reconstructed in the PC6000 software.

Comma and " " delimited files are in ASCII. Each line in the file is terminated with a [CR][LF] sequence (in this order). All basic and calculated sensor readings are included in the file. Each reading is delimited by either a comma ',' or a space depending on the selected radix mark. If the radix mark is a period '.' then a comma is used as the delimiter. Otherwise, a space is used. All strings, times, and date fields are enclosed in double quotes "".   Since the file is in ASCII and contains all calculated sensor readings, the size is larger than the PC6000 format and it will take 2 to 3 times longer to upload. The advantage of this file format is that it is importable to most commercially available spreadsheet and data base software. These programs can be utilized for further data processing and analysis.

The last file format, ASCII text, generates readable reports. It is almost the same as the CDF file format. The differences are:

1. All fields are right justified and have a fixed field width (space pre-filled if required).

2. A report header, containing sensor names and units, is generated for every page. The page length can be set in the Report-setup menu, see Section 4.6.

3. A page header is at the top of each page. It contains the page number and file description.

9.7 MODEM SETUP

6000UPG instruments designated UPG3 on the serial label are wired to support a direct modem interface via the YSI 6105 MS-8 to DB-25 male modem adapter.   Since modems are so diverse in their default factory configuration, it is often necessary to send a "configuration" string to the modem so it will work properly with the 6000UPG. This is typically done through the use of "AT" command sequences sent to the modem once connected.   Please refer to your modem manual for the proper "AT" commands to configure your modem with the following setup:

Desired Action	Zoom 14.4	US Robotics 28.8/14.4
Return to Factory Profile	&F	&F0
Carrier detect follows remote carrier	&C1	&C1
No software or hardware handshake	&K0	&H0&I0
Drop in DTR causes modem to hang up	&D2	&D2
Do not auto-answer	S0=0	S0=0
Display verbal result codes*	V1	V1
Send all result codes (responses)*	X4	X4
Display result codes*	Q0	Q0

* Indicates that this setup is the default configuration for most modems

To program the initialization string into the 6000UPG, from the main menu select **5. System setup**, then **3. Communication**, then **3. Modem Setup**. The following menu will then be displayed

```
=======================================
System-Setup Comm Modem
---------------------------------------
1. Initialization String
2. Answer String
3. Password

Select option (0 for previous menu):


```

```
1. Initialization String
```

Select this option to input the proper initialization string for your modem. Review the table above for proper configuration settings. It is important to note that the above table is not all inclusive and that some experimentation may be necessary, especially when mixing modem brands, to get a working system. The user must include the "AT" portion of the command. An example initialization string for a US Robotics 14.4 modem would be "AT&F0&C1&H0&I0&D2S0=0V1X4Q0".

```
2. Answer String
```

This option identifies the string necessary for the modem to take the phone off-hook (answer). For nearly every modem, this string is "ATA" and will not have to be changed from the default value.

```
3. Password
```

After answering a call, the 6000UPG can prompt for a password before allowing the caller access. When entering a password, the user will be prompted to verify the password before it will take effect. Typing "NONE" at the prompt will remove password protection. If password protection is enabled, the user will see the following screen upon connection.

```
YSI Water Quality Systems Model 6 0 0 0.
EMS6000 version 3.00 (5/24/96).
Copyright (c) 1994, 1996 by
YSI Inc. All right reserved.

Enter password:
```

After three unsuccessful attempts or after 30 seconds with no input, the 6000UPG will hang up. Otherwise the user will resume where they were when last connected.

NOTE: All sonde activity except for unattended sampling is suspended while the sonde is waiting for a call.

Entering modem mode:
  To enter modem mode, exit out of the menu system and return back to the command line. At the "#" prompt, type "modem" and hit return. After connecting the 6000UPG to the modem, the 6000UPG will flash the modem's DTR indicator light to acknowledge that the modem accepted the initialization string and is ready to receive incoming connections. If the DTR light does not flash and you see activity on the modem's RX (receive) and TX (transmit) indicators, insure that the modem answers "OK" to the initialization string and that all cables and adapters are firmly connected.

Exiting modem mode:
  To exit out of modem mode, disconnect the 6000UPG from the modem, attach it with a YSI 6095 MS-8 to DB-9 field cable adapter to your PC and while holding down the Ctrl key type "X" (Ctrl-X). At the prompt, Answer "Y" confirming the intention to exit modem mode.

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 by ingestion and inhalation. Skin or eye contact may cause irritation. Has a corrosive effect on the gastro-intestinal tract, causing abdominal pain, vomiting, and diarrhea. Hypersensitivity 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.

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.

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.

Within the EC the YSI 6000 must at all times be operated only when submerged and deployed under water. When used in-situ under water the YSI 6000 is not liable to cause, nor is its performance liable to be degraded by, electromagnetic disturbances. Similarly, when downloading and retrieving data, the YSI 6000 must at all times be submerged in water. YSI accept no responsibility for any electromagnetic interference that the YSI 6000 may cause should the instrument be used and operated in any other way.

APPENDIX C

WARRANTY AND SERVICE INFORMATION

The 6000UPG sonde is 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, ORP, turbidity probes, and ammonium and nitrate probe bodies are warranted for one year. The ammonium and nitrate sensor modules are warranted for 6 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. This warranty is limited to repair or replacement at YSI's option.

If service is required...

In the USA contact YSI, Yellow Springs, OH.

Telephone: (5I3) 767 7241
             (800) 765 4974 (Toll Free in USA)

Fax: (513) 767 9353

In the United Kingdom, contact YSI Limited, Farnborough, Hampshire, England.

Telephone: 44 1252 51 47 11

Fax: 44 1252 51 18 55

Other parts of the World, contact YSI Incorporated, Yellow Springs, OH, USA.

Telephone: 513 767 7241

Fax: 513 767 9353

APPENDIX D

ACCESSORIES AND REAGENTS

The following components come standard with the purchase of any
6000UPG Environmental Monitoring System.

- 6000UPG Sonde

- Batteries, 8 C-cells (Units with internal battery power only)

- PC6000 Software

- Instruction Manual

- Calibration/Transport Cup

- 6040 Maintenance Kit for 6000UPG

Optional Probes/Sensors

- 6026 Turbidity Sensor

- 6029 Cond/Temp Sensor

- 6030 Pulsed DO/Cond/Temp Probe

- 6031 pH Probe

- 6032 ORP Probe

- 6033 Low Ionic Strength pH Probe

- 6083 Ammonium Probe Kit

- 6084 Nitrate Probe Kit

- 3883 Ammonium Sensor Module

- 3884 Nitrate Sensor Module

Other Optional Accessories

- 6027 Turbidity Wiper

- 6035 Probe Reconditioning Kit for 6030 Probe

- 6036 Carrying case

- 6037 12 VDC power supply with 220 VAC input

- 6038 12 VDC power supply with 110 VAC input

- 6039 12 VDC power supply with 110 VAC input and Conxall connector

- 6040 Maintenance Kit for 6000UPG

- 6043 12 VDC Power Supply with 220 VAC input and Conxall connector

- 6044 Sonde Weight for 6000UPG

- 6045 Mooring Clamp for 6000UPG

- 6046 Flow Chamber for 6000UPG

- 6070 Transport/Calibration Cup (PVC plastic) for 6000 UPG

- 6071 Calibration Cup Kit for 6000UPG (2 cups)

- 6101 Portable Power Pack (Powers 600, 600XL, 610, 6000UPG)

- 5775 Membrane - KCL Kit

Cables

- 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)

- 6067B Low Cost Calibration Cable, Dry use only; 10 ft (3m)

- SP6093-L Special length field cables available in 25 ft (7.6 m) increments; Maximum 1000 ft (305 m)

- 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 6095 Field Cable (6ft)

- 6102: 610 to Portable Power Pack Adapter

- 6103 MS-8 Dust Cover (caps connector when not in use)

- 6105 Field Cable to Modem (DB-25) Adapter

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 (500 mL)

- 3846 200 NTU standard suspension (125 mL)

- 3847 800 NTU standard suspension (125 mL)

Displays, Loggers, and Accessories

- 610-D Handheld Field Display 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

APPENDIX E

APPLICATION NOTE

SENSOR DRIFT COMPENSATION WITH THE 6000UPG

The following application note is designed to facilitate the use of the sensor drift software included in the PC6000 package by providing the user with a specific example. The use of this function is generalized in Section 5.4 of the 6000UPG manual.

Situation

After laboratory calibration, a user deployed their 6000UPG in a readily-accessible stream on 10/14/92 with the instrument set to log data to memory at 15 minute intervals. The study was named SRUN7. The instrument was left in place for approximately 2 weeks and during this time period, the user visited the site 3 times, took a water sample in a sealed bottle, and, on returning to the laboratory, measured the dissolved oxygen and pH with recently-calibrated instruments. The user also collected a water sample when the instrument was retrieved (10/26/92) and measured dissolved oxygen and pH in the laboratory. The following records were kept.

Laboratory Measurements

Date	Time	DO (mg/L)	pH
10/17/92	8:00	5.40	7.62
10/29/92	8:00	7.50	7.63
10/23/92	10:00	7.30	7.58
10/26/92	8:15	6.32	7.60

The user now has everything required to compensate the DO and pH readings for field drift:

• The data file logged to sonde memory.

• The correct DO and pH readings at various times during the study based on grab samples of water which were analyzed with recently-calibrated laboratory instruments.

• PC6000 software for retrieval and manipulation of the data from the sonde memory.

Compensation Procedure

(1) For this example, make certain that the data file is present in a subdirectory of the hard drive (C:\PC6000).

(2) "Exit" from PC6000 software using the top menu bar. The "C:\PC6000" prompt should be displayed.

(3) The user must now write compensation files which contain the above data points and which will be accessed automatically by the PC6000 software. If the "C:\PC6000" prompt is displayed, the files will be located in the same subdirectory as the SRUN7.DAT data file. *A compensation file for each parameter (DO and pH, in this example) must be written.* Since the overall filename is SRUN7.DAT, the DO compensation file will be called SRUN7DO.CMP and the pH compensation file will be called SRUN7PH.CMP. Note that for accurate record keeping, the compensation file name should somehow be related to the name of the overall study. For example, it will become extremely confusing if all dissolved oxygen compensation files are named "DO.CMP" as shown in the brief example in the manual.

(4) To compose the DO compensation file, type the following at the "C:\PC6000" prompt:

```
C:\PC6000COPY CON SRUN7DO.CMP -- (Return)
10/17/92  8:00:00 5.40 (Return)
10/20/92  8:00:00 7.50 (Return)
10/23/92  10:00:00 7.30 (Return)
10/26/92  8:15:00 6.32 (Return)
Control Z (Return)
```

The screen will display "1 File Copied" if all is correct and the file SRUN7DO.CMP will now be in the "PC6000" subdirectory of the C drive. Note that the data must be entered in exactly the above format: (1) The time must contain a designation for seconds even if the user does not know this value exactly; an entry of XX:XX**:00** is suggested for all time inputs and (2) there must be a space between the date, time, and parameter value entries.

(5) To compose the pH compensation file, type the following at the "C:\PC6000" prompt:

```
C:\PC6000COPY CON SRUN7PH.CMP -- (Return)
10/17/92  8:00:00 7.62 (Return)
10/20/92  8:00:00 7.63 (Return)
10/23/92  10:00:00 7.58 (Return)
10/26/92  8:15:00 7.60 (Return)
Control Z (Return)
```

The screen will display "1 File Copied" if all is correct and the file SRUN7PH.CMP will now be in the "PC6000" subdirectory of the C drive.

(6) After writing the DO and pH compensation files to the C:\PC6000 directory, type "PC6000" at the "C:\PC6000" prompt to re-enter the PC6000 software package. Just as would be done for no compensation, prepare the plot and report output format desired by manipulation of the "Parameters", the "Control Information", and the "Scaling Information".

(7) After the format is finalized, re-enter the "Parameters" section of the software. Place the cursor on the "DO (mg/l)" entry, hit "Return", and then select the "Detail this parameter" option within the window.

(8) Move the cursor to the "Compensate" entry and hit "Return". Move the cursor to the "DO, mg/l" entry and hit "Return" to activate the compensation of this parameter.

(9) Hit the "Tab" key once to move the cursor to the right portion of the screen and then enter the location and designation of the DO compensation file in this bar. In this case, the entry is: **C:\PC6000\SRUN7DO.CMP**. Hit "Return" and the screen should appear as follows if the procedure has been followed:

Parameter:	DO (mg/L)
Formula:	Temp (C) Cond (mS/cm) DO (%)
Inputs:	Temperature (C) from 6030* probe, channel 0
	Conductivity (mS/cm) from 6030 probe, channel 1
	DO (%) from 6030 probe, channel 2
Compensate:	DO (mg/L) c:\pc6000\srundo.cmp

(10) Carry out the same procedure for pH:
      (a) Activation of the compensation, and
      (b) Entry of the location and designation of the pH compensation file.

* NOTE: Although the probe part number does not correspond to any of the 6000UPG probes, the probe identification of 6030 is correct for this application.

APPENDIX F

SOLUBILITY AND PRESSURE/ALTITUDE TABLES

Table 1: Solubility of Oxygen in 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.
$S(^0/_{00}) = 1.80655$ x Chlorinity $(^0/_{00})$

Temp ºC	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

Temp ºC	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
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
30.02	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	% sat
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

TO CONVERT FROM	TO	EQUATION
Feet	Meters	Multiply by 0.3048
Meters	Feet	Multiply by 3.2808399
Degrees Celsius	Degrees Fahrenheit	$5/9 \times (^{o}F-32)$
Degrees Fahrenheit	Degrees Celsius	$9/5 \times (^{o}C) + 32$
Milligrams per liter (mg/l)	Parts per million (ppm)	Multiply by 1

Conversion Factors for Common Units of Pressure

	kilo Pascals	mm Hg	millibars	inches H_2O	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_2O	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_2O	0.09806	0.7355	9.8×10^{-7}	0.3937	0.014223	0.02896

APPENDIX G

SENSOR AND SONDE STORAGE RECOMMENDATIONS

The multiparameter equipment associated with the EMS product line from YSI consists of a number of types of sondes which differ in size and function and which, by definition, contain a variety of sensors (or probes) in a compact arrangement where the sensors cannot be separated physically. This arrangement allows the user to concurrently (and conveniently) acquire data from all of these sensors (either in spot sampling or monitoring applications).   The presence of multiple probes in the same unit sometimes results in questions as to the proper procedure for storage of the sensors which will maximize their lifetime and will minimize the time required to get the sonde in shape for a new application. This document is designed to answer most of the questions previously raised by our users with regard to two types of storage requirements:

1. Interim or short term storage between applications where the sonde is being used at a regular interval (daily, weekly, biweekly, etc.).

2. Long term storage, e.g., over-the-winter, where the sonde will not be used on a regular basis for several months.

NOTE: 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 Product 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.

RECOMMENDATIONS FOR INTERIM SONDE STORAGE

Fortunately, the recommended short term or interim storage procedure is very simple and is identical for all instruments (Models 600, 600XL, 6000UPG, and 6820).

No matter what sensors are installed in the instrument, the key is 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. With this in mind, YSI recommends that short term storage of all multiparameter instruments be done **by placing approximately 0.5 inch of water in the calibration and/or storage vessel which was supplied with the instrument and placing the sonde with all probes in place in the vessel.** The use of a moist sponge as a source of humidity is also acceptable, as long as its presence does not compromise the attachment of the storage vessel to the sonde. **The storage vessel 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, but the water level is 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. If storage water is inadvertently lost during field sampling studies, environmental water can be used to provide the humidity.

Thus, interim multiparameter 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.

GENERAL RECOMMENDATIONS FOR LONG TERM STORAGE

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

6000UPG -- Remove all sensors except the combination DO/Conductivity/Temperature probe 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. Leave the DO sensor with electrolyte and a membrane in place. Place approximately 400 mL of deionized, distilled, or tap water in the calibration/storage vessel, insert the sonde into the vessel, and seal to minimize evaporation

600XL -- Remove the pH or pH ORP probe from the sonde and store 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 approximately 300 mL of deionized, distilled, or tap water in the calibration/storage vessel, insert the sonde into the vessel, and seal with the cap/O-ring to minimize evaporation.

6820 -- 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 approximately 300 mL of deionized, distilled, or tap water in the calibration/storage vessel, insert the sonde into the vessel, and tighten the threaded cup to attain a good seal and minimize evaporation.

600 (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 which 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 which 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 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 which 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.

RECOMMENDATIONS FOR LONG TERM STORAGE OF INDIVIDUAL SENSORS

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

TEMPERATURE

No special precautions are required. Sensors can be stored dry or wet, as long as solutions in contact with 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 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 6000UPG, the 600XL, and the 6820, two long term storage methods are equally acceptable.

❑ Remove all probes other than dissolved oxygen, conductivity, and temperature from the sonde and seal the vacant ports with the provided plugs. Leave the electrolyte and membrane in place on the dissolved oxygen sensor. Fill the provided storage vessel 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 remembrane the probe using new electrolyte.

❑ 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 the 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 remembrane the probe using new electrolyte.

Because the dissolved oxygen probe associated with the Model 600 cannot be removed from the sonde by the user, 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 insert which 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. **However, 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 remembrane 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 which 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 remembrane the probe using new electrolyte.

pH

The key to pH probe storage, either 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 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 Model 6000UPG, 600XL, and 6820 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. Electrical tape can be used to provide a removable seal between the boot and the module body.

For Model 600 systems equipped with a replaceable reference electrode module, remove the reference module and plug the open port with the insert which was provided. 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 which must remain in the sonde.**

For Model 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 Model 600. For the Model 6000UPG, 600XL, and 6820 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 AND NITRATE

The active element in these ion selective electrode sensors is a polyvinyl chloride (PVC) membrane which is impregnated with the reagent which 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 <u>dry</u> air is slightly preferable for general storage, the short term storage of these sensors in the sonde, with the entire sensor array in <u>moist</u> air, will have no significant detrimental effect on the life of the membrane. Remove the sensor module (6820) or the probe (6000UPG) from the sonde and cover the vacant port with the provided plug. Place the sensor back in the storage boot which was provided, and set aside in room air.

TURBIDITY

No special precautions are necessary for either the short or long term storage of the turbidity sensors for the Models 6000UPG and 6820. However, for long term storage, the user may wish to remove the sensor from the sonde and store it dry in air to minimize any cosmetic degradation of the probe body and to maximize the life of the wiper on the 6026.

DEPTH/LEVEL

No special precautions are required. 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.

APPENDIX H

TURBIDITY MEASUREMENTS WITH THE 6000UPG

**A QUESTION/ANSWER GUIDE TO HELP YOU OPTIMIZE PERFORMANCE
AND TROUBLE SHOOT PROBLEMS.**

Introduction

The turbidity system of the Model 6000UPG is characterized by a great deal of flexibility from the point of view of the user. For example:

❏ The mechanical wiper can be activated manually or automatically via the sonde software;

❏ The data from the turbidity sensor can be processed via a sophisticated filtering algorithm and the extent of the filtering can be defined by the user;

❏ The turbidity system can be used in spot sampling applications with our 610-D or 610-DM data loggers or can be used for long term unattended monitoring studies either in a stand-alone deployment or attached to a data collection platform;

❏ A number of calibration options are offered with the 6000UPG turbidity system.

YSI consciously designed in this versatility because we believe that these options are necessary to produce high quality turbidity readings under the wide variety of environmental applications likely to be encountered in water quality assessment programs. However, we also appreciate the fact that the existence of this flexibility requires the user to make more decisions with regard to setup, calibration, and use than for a simpler sensor such as conductivity, and that sometimes the basis for these decisions with regard to operation can be confusing to the first-time user. This section is designed to help the user attain the maximum possible benefit from the 6000UPG 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 which may be asked by a typical user of the 6000UPG with our 6026 turbidity sensor. It does not deal with specific instructions for operation of the 6000UPG at the level presented elsewhere in the manual. Therefore, be sure to read the parts of these sections outlined above which deal with turbidity in order to get the maximum benefit from this appendix.

Question 1 : Why do I need a sensor with mechanical cleaning?

You can get by without mechanical cleaning in **spot sampling** applications -- YSI offers such a probe (6036) for use with our Model 6820. However, the 6000UPG is used primarily for long term **unattended monitoring** studies where the 6000UPG is sending readings to internal memory, a data collection platform or computer on a regular interval over a long period of time (days or weeks). For this application, the mechanical cleaning capability of the 6026 provides very

significant benefit and more than likely will be necessary for most deployments.   Even if fouling from chemical or biological sources is not a significant problem in your unattended application, it is likely that bubbles will form on the optical surface during deployment and result in the transmission of erroneous readings.   Further, once bubbles have formed, they can remain in place for long periods of time, resulting in corrupted readings for the majority of the study. YSI feels that mechanical cleaning is a necessity for unattended monitoring of turbidity.

Question 2: Where should I get my turbidity standards?

Naturally, we recommend that you obtain your standards from YSI. We sell 100 NTU standard which 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 which 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 which 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, however, be very safety conscious if you use it and be sure to follow the manufacturer's instructions with regard to its handling and disposal.

Finally, it is important that you do **not** use standards which 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 6000UPG 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, 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. However, we do 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. However, these occasions are rare. Just be sure to use purified water that is visually free of any suspended material.

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 6000UPG is reasonably appropriate for the "average" 6026 sensor, you should always carry out some multipoint calibration (2- or 3-point) prior to your first usage to make certain that your system meets the YSI accuracy specifications provided in the 6000UPG manual. For the accuracy required in almost all environmental applications, a 2-point calibration is sufficient, and we recommend 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 which is actually 6.0 NTU would read about 5.4 NTU on the average probe.

Once the initial multipoint 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 multipoint calibrations?

Of course, there can be no firm answer to this question which is frequently asked not only for turbidity but for most of the other sensors in the 6000UPG array. 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.

We can state that our empirical testing has indicated that the optical system of the 6026 probe is very stable and is likely to require only infrequent calibration (for example, monthly) to remain within the accuracy specifications of the instrument (+/- 5 % of reading or 2 NTU). 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 multipoint calibrations.

Question 6: What about smoothing of turbidity data with the 6000UPG?

As described in **Section 6. Principles of Operation** of the 6000UPG manual, some processing of raw turbidity data is usually beneficial in terms of outputting values which reflect the "average" turbidity at the site.

The extent of the filtering is defined during activation of the turbidity sensor in the Sensor setup menu of the sonde software. During activation, you will be asked to input a value (1 to 15) for "Number of Samples to Average". The larger this number, the smoother the data presentation, but the slower the response of the turbidity sensor to abrupt changes in turbidity. For most applications involving both spot sampling and monitoring, **we recommend that the "Number of**

Samples to Average" be set to 8. We feel that this setting will normally produce data which is reflective of the "average" turbidity of field sites, but will not slow the response time so as to result in any significant inconvenience to the user during calibration.

If the user wishes to view "instantaneous" turbidity events rather than the "average" turbidity at a site, the data smoothing can be reduced by lowering the value of the "Number of Samples to Average" or can be eliminated completely by entering a value of **1.**

CAUTION: With the recommended setting of 8 in place, it is important to remember to wait at least 32 seconds before confirming a calibration or before recording field reading in a spot sampling application. Otherwise, the readings may be biased by the averaging until 8 samples have been processed

Question 7: How do I manually activate the turbidity wiper on a 6026 when the 6000UPG is sampling?

If you are using the 6000UPG/6026 with a 610, press the "T" key to activate the wiper. If the 6000UPG is connected to a computer (sequential lines of data are present on the screen), press the "3" key to activate the wiper.

IMPORTANT TIP: While connected to a computer, the wiper can also be manually activated by pressing the "3" key while in the Calibrate and Diagnostic modes. The user may be unaware of this feature since no screen prompt to this effect is present.

Question 8: What are the things most likely to give me problems when measuring turbidity with the 6000UPG?

We feel that that the 6000UPG turbidity system has been designed to be easy to calibrate, easy to use in both sampling and deployment applications, and troublefree 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 6000UPG 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 Discreet Sampling at a 4 second interval 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. Activate the wiper or 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 which 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. The problem is almost always caused by bubbles on the optics. Activate the wiper or 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 which you think are too jumpy. If this occurs, the water may be nonhomogeneous with regard to the size of the suspended particles. The jumpiness which you are observing is probably real. However, if you want to smooth it out, you can incrementally increase the value of "Number of Samples to Average". Remember, that this will result in an increase in the response time of the turbidity sensor so you will be required to wait longer before recording readings.

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 I

SYSTEM ERRORS AND WARNINGS

WARNING: Low RTC battery	Lithium battery that powers the real time clock is low. Replace lithium battery.
ERROR(000): Undetermined	Internal error. The system is unable to determine the cause. Repeat action. If necessary reset by removing the battery lid and repeat action.
ERROR(001): Illegal input conversion	Internal error. The system encountered an unknown character in the last I/O conversion. Repeat action.
ERROR(002): Conversion overflow	Input number exceeds system limit.
ERROR(003): Input error	User input error.
ERROR(004): Input out of range	Input number exceeds allowable range.
ERROR(005): Illegal hex nibble	System encountered bad data during system software update.
ERROR(006): Illegal address	System encountered bad address during system software update.
ERROR(007): Illegal record	System encountered bad record during system software update.
ERROR(008): Illegal page number	System encountered bad code page during system software update.
ERROR(009): Mismatch hex checksum	System has detected bad checksum during system software update.
ERROR(010): Hex load abort	System has detected abort sequence during system software update.
ERROR(011): SFLS erase suspend	Internal error. System software erasure was suspended.
ERROR(012): SFLS erase fail	Fatal hardware failure. Unable to remove old code during system software update. Battery is low or program failed to save system setup information.
ERROR(013): SFLS program fail	Fatal hardware failure. Failed to update system software or failed to save system setup.
ERROR(014): SFLS VPP low	Fatal hardware failure. Unable to raise programming voltage or low battery voltage.
ERROR(015): SFLS command sequence	Internal error. Bad programming sequence during system software update.
ERROR(016): Write to occupied sflscell	Internal error. Hardware failure during system software update.
ERROR(017): SC timeout	Internal error.
ERROR(018): SQ empty	Internal error.
ERROR(019): SQ full	Internal error.
ERROR(020): Rx overrun	Internal error.
ERROR(021): Rx framming	Internal error.
ERROR(022): Rx parity	Internal error.
WARNING: High DO charge	DO charge current exceeds limit (25 to 75 during calibration. Probe maintenance is required.
WARNING: Out of range	Calibration procedures determine that actual solution and user inputted number cannot be resolved.
ERROR: Sensor disabled	System is not configured with appropriate sensor for calibration.

Error Table continued...

ERROR: Need 2 at same conc	A 3 point ammonium or nitrate calibration requires that two of the three calibration solutions be of the same concentration, but of significantly different temperature.
ERROR: Illegal value	During calibration an illegal value has been entered.
ERROR: Cal canceled by user	User has canceled calibration.
ERROR(038): FDDT allocation	Internal error.
ERROR(039): Unformatted Flash disk	Flash disk has never been formatted or has been corrupted. Format the flash disk.
ERROR(040): File not found	Incorrect file number.
ERROR(041): Invalid file number	Incorrect file number.
ERROR(042): Unable to create new file	Number of files in Flash disk has reached 23. The Flash disk can only hold a maximum of 23 files including all erased files. Upload all existing files then format the Flash disk.
ERROR(043): Flash disk full	Flash disk is full. Upload all existing files then format the Flash disk.
ERROR(044): BAD Flash disk. Check Vpp	Fatal hardware failure. Programming voltage failed. Check battery voltage.
ERROR(045): End-of-file	Internal error.
ERROR(046): Bad Flash disk block	Internal error.
ERROR(047): Invalid block number	Internal error.
ERROR(048): Unexpected end-of-file	Internal error.
ERROR(049): Bad file link	Internal error.
ERROR(050): Unknown trap service	Internal error.
ERROR(051): Invalid record number	Internal error.
ERROR(052): Bad record	Internal error.
ERROR(053): Unable to format Flash disk	Flash disk is degrading. System failed to format Flash disk. Reformat Flash disk.
ERROR(054): Flash disk test fail	Fatal hardware failure; if Flash disk format was successful but Flash disk test failed.
ERROR(055): File not found	Internal error.
ERROR(056): No active file	Tried to close an unopened file.
ERROR(057): Kermit upload canceled	Kermit file transfer has detected an aborted sequence.
ERROR(058): Kermit upload timeout	Kermit file transfer timeout. Communication link is broken or the host system failed to initiate a Kermit receiving sequence.
ERROR(059): Unattended mode active	Tried to run a conditional sample while the system is in unattended mode.
ERROR(060): File open	When the Model 6000 is in unattended mode or the 1st data point is logged to flash disk from either a discrete or unconditional sample, the system time and date and sensor setup are not accessible.
ERROR(061): Discrete sample not active	Internal error.
ERROR(062): Stop time less than start time	Internal error.
ERROR(063): Stop time less than current time	Internal error.
ERROR(064): Unknown	Internal error.