SCOUT®2

Display Unit

Operating Manual

January 1994

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Scout ® 2 Display Manual
ADDENDUM
December 1993

(upgrades Scout 2 Display Operating Manual to Revision C)

This addendum updates the Scout 2 manual for the addition of turbidity. It assumes knowledge of the Scout 2 manual. The section numbers reference the pertinent section of the manual which is modified or updated.

PART ONE: INTRODUCTION

New Firmware

All Scout 2 Displays shipped after December 15, 1993 will contain firmware revision 2.10 or higher. The firmware revision number is shown on the start-up screen:

Scout 2, Ver 2.10
(C)1991, Hydrolab

The new firmware provides compatibility with Hydrolab's DataSonde 3 Multiprobe Logger with firmware revisions 1.40 and higher, H20 Multiprobes with firmware revisions 2.00 and higher, and Reporter Multiprobes with firmware revisions 1.04 and higher. Older H20s and DataSonde 3 multiprobes will remain compatible as well.

Generally, the Scout 2 firmware has been modified to support the addition of the turbidity sensor to the DataSonde 3 and the H20 Multiprobes.

PART TWO: DATA DISPLAY & MENUS

When the Scout 2 is attached to a multiprobe capable of operating a turbidity sensor, the turbidity reading will appear on the Alternate Data Screen in the lower left corner. The reading will be suffixed with an "ntu" unit code and replaces the dissolved oxygen (% saturation) reading.

The dissolved oxygen (mg/l) position on the Main Data Screen will now be either the mg/l reading (no unit code suffix) or the percent saturation ("%" unit code suffix) reading depending on the multiprobe setup options.

The Data Status Screen has been modified to show the alphanumeric flags provided by the multiprobe in the screen positions occupied by the readings. For example, if your pH reading is uncalibrated, then pressing the down-arrow key will show an asterisk (*) in the pH location on the screen. The alphanumeric flags for the six parameters on the Main Data Screen will also appear in the appropriate locations. To view the flags for the parameters on the Alternate Data Screen, just press Screen/Escape key.

Press the down-arrow key again to return to the normal data display or the normal data display will return automatically after a few seconds.

The new alphanumeric flags are interpreted as follows:

ok	Data is ok (nothing to report)
N/A	The appropriate sensor has not been installed or has been disabled
?	Turbidity sensor error (Refer to the multiprobe Operating Manual)
!	Warm-up batteries are enabled
$	Stirrer has been disabled (DataSonde 3 only)
@	Parameter not compensated, turbidity neph only

Calibrate Menu

Turbidity (Y) has been added to the Calibrate menu:

pCS%OYRTA: Turb

If you have an older multiprobe that does not support turbidity, then you will see the following message if you try to calibrate turbidity:

Menu not available

Variables Menu

1. Turbidity

Turbidity (Y) has been added to the Variable menu:

TCODSY: Turbidity

This menu allows you to modify the turbidity operating mode as outlined in your multiprobe Operating Manual. If your multiprobe does not support turbidity, you will get the "Menu not available" message.

2. Dissolved Oxygen

The dissolved oxygen Variable menu has been modified to allow you to select the type of dissolved oxygen reading to display on the Main Data Screen, since the turbidity reading replaces the dissolved oxygen percent saturation reading on the Alternate Data Screen. You will not see this menu if your multi-probe does not support turbidity since both dissolved oxygen readings are available simultaneously.

System Menu

1. Display Contrast

Hydrolab now uses high contrast "super-twist" display modules that no longer require a contrast adjustment therefore, the display contrast adjustment has been removed from the System Menu.

2. Warm-Up Batteries

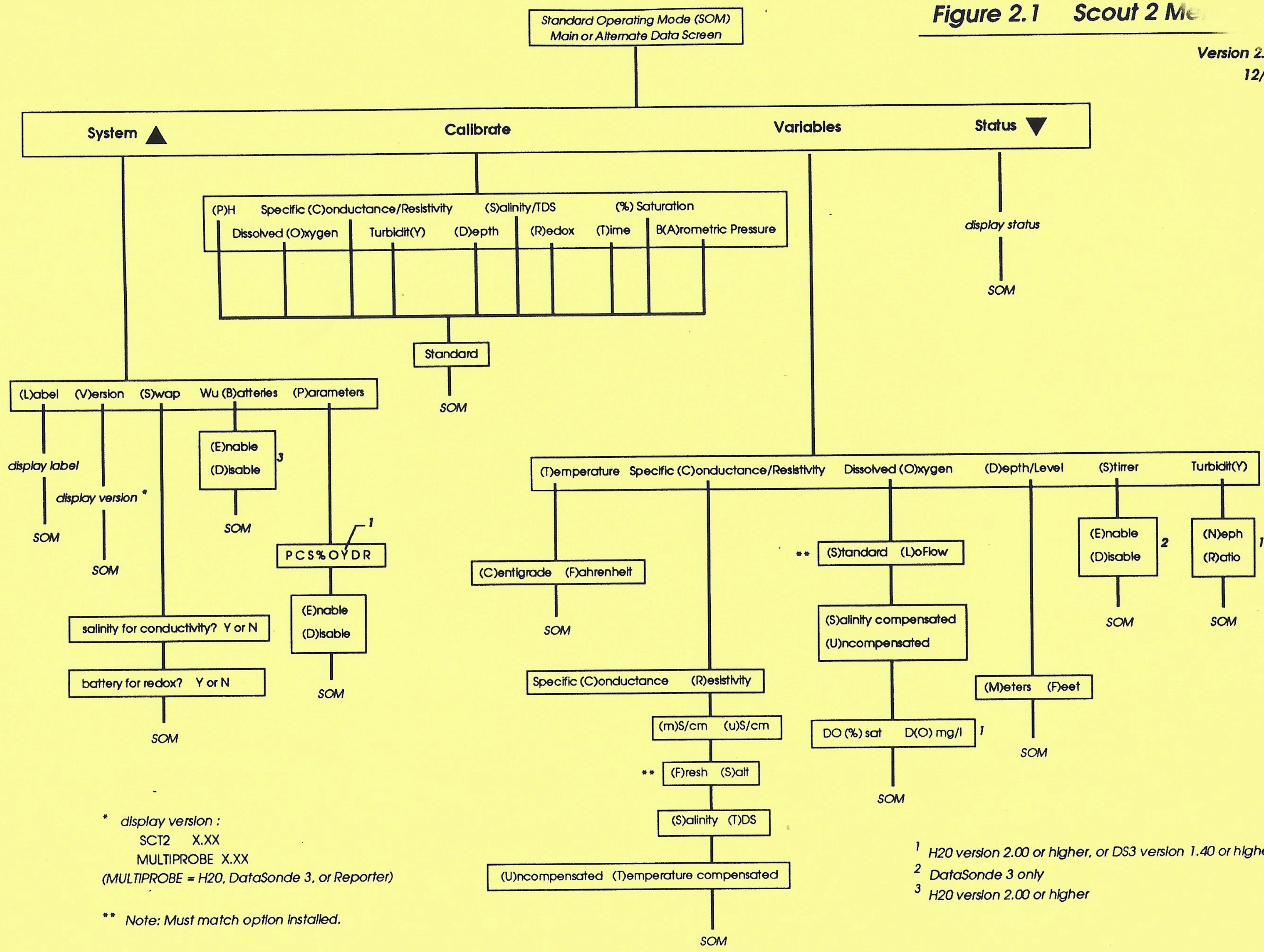
You can enable or disable the warm-up batteries in H20 Multiprobes with firmware revisions 2.00 and higher by selecting the B menu option. Refer to the H20 Multiprobe's Operating Manual for further details concerning warm-up batteries.

3. Parameters

Turbidity has been added to the Parameters menu.

Figure 2.1 Scout 2 Me

Version 2.10
12/93



* display version :
SCT2 X.XX
MULTIPROBE X.XX
(MULTIPROBE = H20, DataSonde 3, or Reporter)

** Note: Must match option installed.

[1] H20 version 2.00 or higher, or DS3 version 1.40 or higher
[2] DataSonde 3 only
[3] H20 version 2.00 or higher

Scout® 2 Data System Operating Manual
ADDENDUM
October 1991

(upgrades Scout 2 Display Unit Operating Manual to Revision B)

PART ONE: Introduction

All **Scout 2** Display Units shipped after October 1, 1991 contain software version 2.00 or higher. The new software requires the new Revision A printed circuit board. The software version number is shown in the start-up screen:

Scout 2, Ver 2.00 **(C)1991, Hydrolab**

The new software version provides:
1. Compatibility with Hydrolab's **DataSonde®** 3 Water Quality Multiprobe Logger
2. Audio feedback for the keyboard
3. Stirrer control
4. Parameter display control

PART TWO: DataSonde 3 Multiprobe Compatibility

With version 2.00 (or higher), the Scout 2 Display Unit connects directly to any DataSonde 3 Multiprobe Logger with software version 1.22 or higher. The Scout 2 Display Unit will display all of the DataSonde 3 readings, however, all logging-related functions must be carried out using a terminal or computer (PC). All Calibration and Variable menus are as described for the H20® Multiprobe except the Stirrer control.

The Data Status Screen now indicates the type of instrument that you have connected. The instrument software revision number is shown in the "Version" function of the System menu.

PART THREE: Keyboard Audio Feedback

The Scout 2 Display Unit now has additional hardware that gives you an audio "beep" each time a key is pressed. The audio beep cannot be disabled.

PART FOUR: Stirrer Control

When using the Scout 2 with a DataSonde 3 and a Stirrer, you can conserve battery life by turning the Stirrer off when it is not needed. Remember that the Stirrer may still operate if a programmed logging event in the DataSonde 3 has the Stirrer enabled. Access the Stirrer control in the Variables menu:

Variables **TCODS: Stirrer**

Press the Enter key to select the Stirrer Variable menu:

Stirrer On **YN: No**

This menu indicates the current status of the Stirrer. If the Stirrer is enabled, the cursor will be flashing on the Y (yes). If the Stirrer is disabled, the cursor will be flashing on the N (no). Use the Right or Left arrow key to position the cursor to the desired menu option, and press the Enter key.

The Stirrer cannot be controlled from the Scout 2 if you are using an H20. The Stirrer must be physically disconnected from the cable to turn it off. If you attempt to turn the Stirrer on or off using the Scout 2 (and you are using an H20), then you will get the following momentary error message:

```
No H20 Stir Control
```

PART FIVE: Multiprobe Parameter Control

This new System menu feature allows you to further customize your Scout 2 by removing any undesired water quality parameters that may clutter the data display. The Scout 2 no longer automatically enables all of the water quality parameters.

The pH, specific conductance/resistivity, salinity/TDS, dissolved oxygen (both % saturation and mg/L), redox, and depth readings can be removed (disabled) or placed (enabled) on the Scout 2 screen. To enable or disable a parameter, access the Scout 2 menu by pressing the Up arrow key:

```
System Menu
LVSCP: Label
```

Move the flashing cursor to the letter P in the menu using the Right or Left arrow key:

```
System Menu
LVSCP: Parameters
```

Press the Enter key to select the Parameters menu option:

```
Parameters
pCS%ODR: pH
```

Move the flashing cursor to the desired parameter using the Left or Right arrow key and then press the Enter key to get:

```
pH
ED: Enable
```

In this example, the desired parameter was pH as displayed on the top line. To display the pH parameter, just press the Enter key (since Enable was already selected). If you wish to disable the pH parameter, then use the Right or Left arrow key to select the Disable option and then press the Enter key. The start-up screen will be displayed for a few seconds while the parameter change is being executed.

Note that any parameters that are disabled will not appear on the Scout 2 data display and will be replaced by a string of five dots (.....). If you try to enable an H20 parameter that does not have a corresponding probe installed then the string of dots will still be shown in the Scout 2. If you try to do this on a DataSonde 3 then the parameter will be enabled, but the reading will not be valid. All of your parameter settings will be retained in the H20 or DataSonde 3 when the Scout 2 is disconnected or turned off.

ART SIX: Revised Battery Life Estimates

The estimated battery life for the Scout 2 has been revised. The following table gives the new battery life estimates for the Scout 2 System:

Sct 2 Configuration	Sct 2 Power Source Internal (hrs)	Hydrolab RBP-6AH (hrs)
DataSonde 3 Multiprobe Logger	10	32
DataSonde 3 *with Stirrer*	7.5	24
H20 Multiprobe	13.8	44.5
H20 Multiprobe *with Stirrer*	10	32

These battery life estimates assume an operating temperature of 25°C and a 100 meter cable length. The values will vary considerably with operating temperature, Stirrer condition, cable length, and brand of battery.

PART SEVEN: Helpful Notes

1. The Hydrolab H20 Multiprobe initially was restricted to communication at 1200 baud. In May, 1991, 300 baud and 2400 baud communication rates were added as user options on H20 software versions 1.02 or higher. The H20 must be set to communicate at 1200 baud before operation with the Scout 2. DataSonde 3s with software versions 1.22 or higher will also need to be set for 1200 baud communications before connection to the Scout 2.

2. The Scout 2 Display Unit cannot:
   - calibrate the Label, Interval, and Message functions,
   - access any of the DataSonde 3 Autolog or logging functions,
   - change the baud rate, SDI-12 settings, or Conductivity ranging.

3. The Scout 2 will automatically enable the DataSonde 3 expert mode. To disable the expert mode when using a terminal or PC after using the Scout 2, refer to the DataSonde 3 Operating Manual.

4. Contact Hydrolab Customer Service for more information.

Scout® 2 Display Unit Operating Manual
ADDENDUM
September 1991

(upgrades Scout 2 Display Unit Operating Manual to Revision A)

This ADDENDUM replaces Section 3.12 (Changing the Scout 2 Display Unit Internal Batteries) for Scout 2 Data Display Units with revision B and higher.

Changing the Scout 2 Display Unit Internal Batteries

The display unit internal battery pack consists of a plastic holder containing 10 "AA" size batteries. You should generally use good quality alkaline type batteries to provide the longest service life. When the low battery indicator becomes activated (when the multiprobe battery reading drops below 10.0 volts) you should make plans to change the internal batteries (or recharge your external battery). The internal battery pack (when using alkaline cells) will operate your display unit and multiprobe with an attached Stirrer for at least 11.5 hours.

To change the internal batteries, begin first by disconnecting the underwater cable from the display unit and remove the display unit case from the bottom of the rubber boot. Use a Phillips screwdriver to remove the vent screw on the side of the case. The vent screw is used to relieve any pressure that may have accumulated in the case interior. Turn the case upside down on a soft pad (to avoid scratching the keyboard and display window) and use a flat-blade screw-driver to loosen the four screws on the bottom of the case. Loosen each screw a few turns then proceed to another screw to avoid undue stress on the case. When all four screws are loose, carefully move the bottom portion of the case to one side and disconnect the battery holder from the wiring harness. The battery holder is connected to the wiring harness using a small latching connector that is separated by pressing the retaining clip and pulling the two halves apart.

Remove the expired batteries and install 10 fresh "AA" alkaline batteries being very sure to note the polarity markings on the battery holder and that the batteries are firmly seated in the holder.

Do NOT install the batteries incorrectly, attempt to charge, or dispose of in fire. The battery may explode or leak causing material or bodily damage.

Reconnect the battery holder into the wiring harness by pushing the two connector halves together until the retaining clip engages. Carefully position the battery holder over the case and place the connector in the space at the end of the holder so that it will not be in the way when the screws are tightened. Tighten all four screws securely and install the vent screw. Tighten the vent screw until the o-ring just compresses against the case. Be careful not to damage the vent screw o-ring by using excessive force.

Do not forget to install the vent screw!

Replace the rubber boot by inserting the display unit case from the bottom and working the rubber boot around the case. Connect your multiprobe and verify proper operation. The battery reading from the multiprobe should now be about 15 volts.

When using an external power source for an extended length of time, you should always remove the internal batteries so that they will not be discharged. An error message will appear if you attempt to use an external power source when you have internal batteries installed. See Section 6.2.

Foreword

The **Scout® 2 Display Unit** performs with any Hydrolab Water Quality Multiprobe. These are the **H20® Multiprobe,** the **DataSonde® Multiprobe Logger,** the **Reporter™ Multiprobe,** and the **2" H20®G Multiprobe** (for groundwater monitoring). The result is a portable, handheld system that can quickly perform short-term monitoring or sampling of water quality with no other equipment required.

A Hydrolab multiprobe measures **temperature, pH, dissolved oxygen** (both mg/L and percent saturation), **specific conductance** (milliSiemens/cm, microSiemens/cm), or **resistivity** (Kohms-cm), **turbidity** (NTUs), **salinity** (parts per thousand) or **total dissolved solids** (Kmg/L), **depth or level** (meters or feet), and **redox** (millivolts) in lakes, rivers, streams, process pipes, bays, estuaries, tanks, sewers, or other large or small water bodies.

The Scout 2 Display Unit formats the multiprobe data output onto an liquid crystal display that allows simultaneous, real-time viewing of up to six water quality parameters. The Scout 2 Display Unit is built into a rugged, handheld, waterproof package suitable for harsh field conditions.

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PART ONE: INTRODUCTION

1.1 Components and Assembly

Use *Figure 1.1* to identify the Scout® 2 Display Unit, Hydrolab Water Quality Multiprobe, and the available battery and cabling options, as well as other parts of the Scout 2 System.

To assemble the Scout 2 System, begin by connecting the Underwater Cable to the Multiprobe. Be certain to note that the Multiprobe connector is keyed (one pin is larger than the others); do not force the connection. If you will be using the Hydrolab Stirrer, be sure to connect it to the 2 pin connector on the Underwater Cable as well. Then, connect the other end of the Underwater Cable (a six pin, metal shell connector) to the mating connector on the left side of the Display Unit. This is a twist-lock connection.

The Display Unit can operate using the included internal batteries or alternatively, an external battery may be used. The external battery can be Hydrolab's RBP-6AH rechargeable 12-volt gel cell or any other 12-volt battery. The external battery is connected to the Display Unit using the 4-pin are using a non-Hydrolab battery, use the AUX-PC Auxiliary Battery Cable; be sure to observe the polarity markings (red terminal is positive, black terminal is negative or ground). When using an external battery you should remove the internal batteries from the Display Unit so that they will not be discharged (an error message will be displayed if you have both power sources connected). See **Section 3.12** for information on how to remove and install the Scout 2 internal batteries.

WARNING: CONNECTION OF HYDROLAB INSTRUMENTATION TO ANY POWER SOURCE THAT IS IN ANY WAY CONNECTED TO A VOLTAGE SOURCE RATED OVER 18 VOLTS CAN RESULT IN ELECTROCUTION THAT CAN KILL YOU. DO NOT USE A TRANSFORMER THAT PLUGS INTO THE WALL TO PRODUCE A LOW-VOLTAGE SUPPLY. USE ONLY BATTERIES THAT PRODUCE A TOTAL VOLTAGE OF LESS THAN 18 VOLTS DC.

Press the On/Off key (in the lower right corner of the Display Unit panel) to verify operation of your Scout 2 System. You should immediately see a start-up message followed by a data display. The Multiprobe is now continuously sending data to the Display Unit for presentation on the liquid crystal display. Press the On/Off key again to turn off the Display Unit. (The Display Unit On/Off key controls power to the Multiprobe as well as the Display Unit itself). If you are unable to get your Scout 2 System to operate correctly, please refer to Part Six.

Please refer to the H20, H20G or DataSonde Water Quality Multiprobe Operating Manual for further details on the operation of any specific Multiprobe options that you may have.

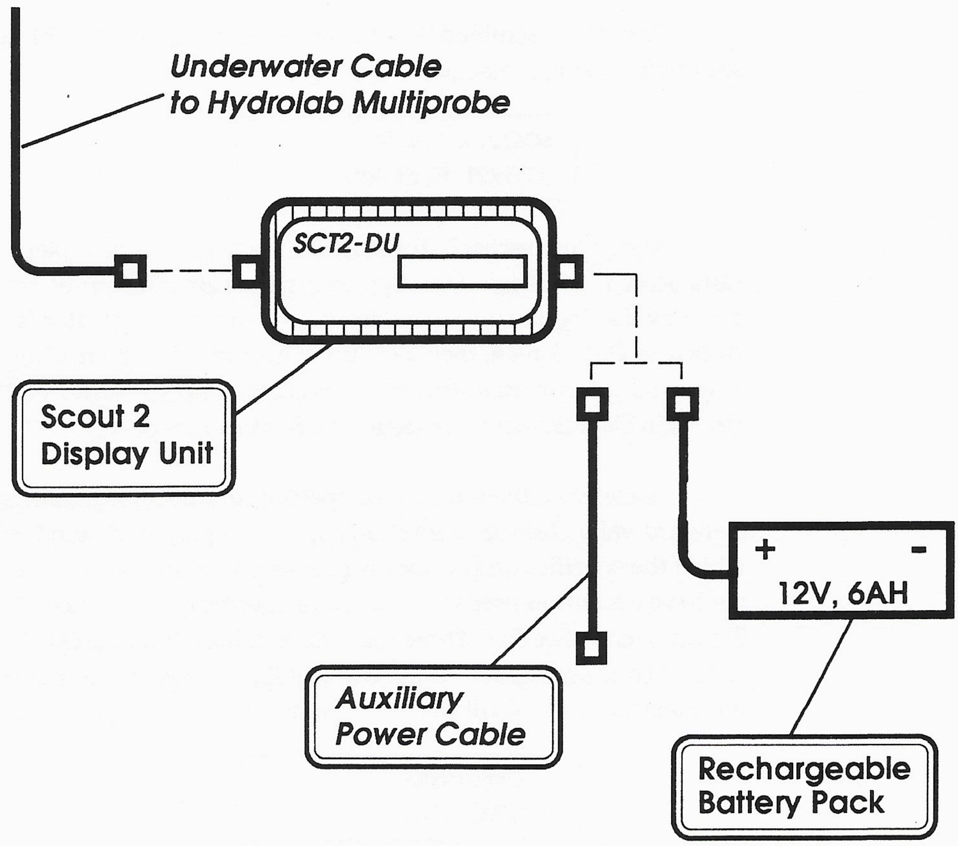

Figure 1.1 Scout 2 System Components

1.2 Introductory Exercise

In order to acquaint you with the basic display unit operation, suppose we are going to calibrate specific conductance and then go to the lake to make some measurements.

Turn the assembled Scout 2 on by pressing the On/Off key. You will see the following message:

```
SCOUT 2, V.1.00
(C)1991, Hydrolab
```

After a few seconds, the start-up message will be replaced by the Main Data Screen. The Main Data Screen displays six multiprobe readings indicated by the display unit panel icons. If a previous operator had utilized the Alternate Data Screen, then a group of four multiprobe readings will be displayed that are identified by units characters (see Section 2.2). Return to the Main Data Screen by pressing the Screen/Escape key.

To calibrate the multiprobe specific conductance readings to a known standard value, fill the calibration cup with a prepared standard solution for which the specific conductance is precisely known. For this example assume we have a solution prepared that has a specific conductance of 1.417 milliSiemens/cm. (See Part Three for further calibration details). When the specific conductance readings have stabilized (this might require one or two minutes), press the Calibrate key to enter the Calibrate menu as follows:

```
   Calibrate
PCS%OARDT:   PH
```

The cursor is flashing on the first letter P, for pH, so use the right-pointing arrow key to move the cursor over one space to the letter C to get:

```
   Calibrate
PCS%OARDT: Sp Cond
```

When you have obtained the proper menu selection, press the Enter key to begin the specific conductance calibration sequence. You will see the following screen:

```
   Calibrate
Sp Cond      1.425
```

The bottom line of the display will show you that specific conductance is currently being calibrated and that the last available reading from the Multiprobe was in this example, 1.425. The cursor will be flashing on the first digit of the Multiprobe reading. The last two significant digits will need to be changed from 25 to 17 to make the specific conductance reading match our calibration standard. Press the right-pointing arrow key twice to move the flashing cursor to the second least significant digit (the 2). Then press the downward-pointing arrow key to change the selected 2 to a 1 to get:

Calibrate Sp Cond 1.415

To set the last digit, press the right arrow key once more to move the cursor right one space in the value to select the least significant digit (the 5). This time, use the upward-pointing arrow key to change the digit from a 5 to a 7 to get the following value:

Calibrate Sp Cond 1.417

Since this is now the value of the calibration solution, press the Enter key to continue. Next you will be asked if you really want to save this calibration:

Save New CAL YN: No

Since the cursor is flashing on the letter N, for No, use the right or left arrow key to select the Y or Yes option:

Save New CAL YN: Yes

Press the Enter key again to fix the calibration value (the start-up message will be displayed during this time). The Display Unit automatically requests a specific conductance calibration sequence and sends the new specific conductance value to the Multiprobe. If a valid calibration was accomplished, then the Scout 2 will return to either the Main Data Screen or the Alternate Data Screen after a few seconds. However, if the calibration could not be accomplished, then an error message will be momentarily displayed:

CAL out of Range

The Display Unit will then return to the data display screen after a few seconds. Note that any of the above menu sequences can be cancelled and the data display screen returned by pressing the Screen/Escape key.

The Scout 2 System is now ready to go to the lake and perform some specific conductance measurements for you. You can freely turn the power on or off without losing calibration which will remain in effect until changed by another calibration sequence. When the Multiprobe has been lowered into place in the lake water, the specific conductance can be read directly from the Display Unit.

1.3 Display Unit Front Panel

The Display Unit front panel consists of a 2 line by 20 characters per line liquid crystal display and a nine position keyboard as shown in *Figure 1.2.* The display provides all information and prompting to the operator. The keyboard is used to alter the Display Unit operating modes as well as the Multiprobe operating modes and calibration settings.

1.4 The Multiprobe as a Stand-Alone Instrument

The Multiprobe is a very powerful instrument that can be operated in a variety of configurations. For example, the Multiprobe can be used directly with a computer or terminal device other than the Display Unit. A DataSonde Multiprobe may be left unattended to take measurements remotely and store data in its internal logger for later downloading. Be certain to read the Multiprobe Operating Manual in order to utilize the full potential of your Multiprobe.

1.5 Important Note

Although you have now performed several of the basic operations available from the Scout 2 System, please read Part Two to discover the System's other features. Also be sure to read Part Three, since only a well maintained and carefully calibrated instrument will provide quality data.

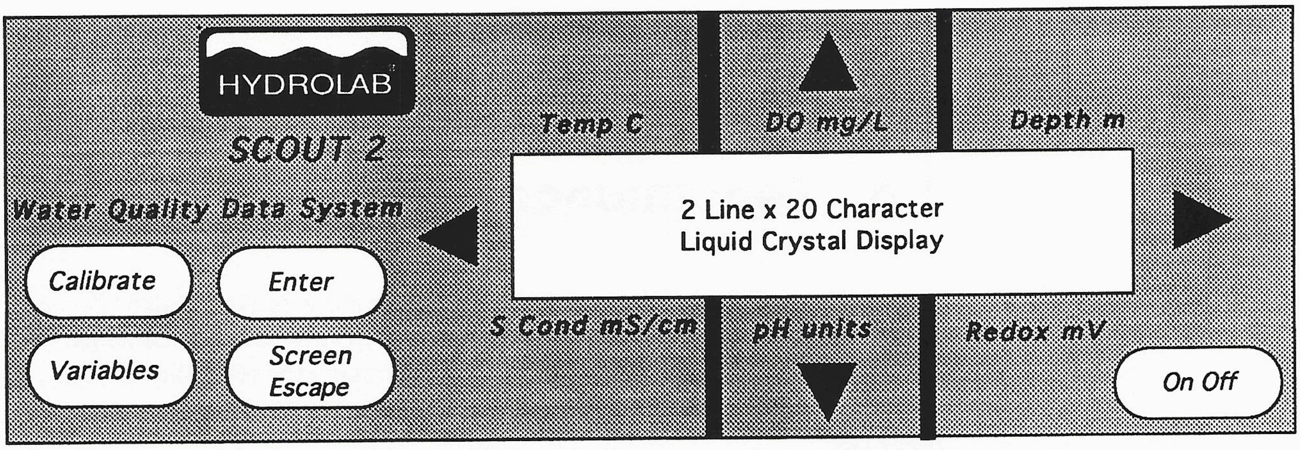

Figure 1.2 Scout 2 Display Unit Panel Keys

The remainder of this manual, although primarily reference material, should also be read.

1.6 Performance Manual

You will find at the end of this manual, a copy of Hydrolab's *"Performance Manual for Field Water Quality Instrumentation"*. This article contains many helpful hints for both qualifying and improving the reliability of your data. You might be surprised to find out what your Hydrolab instrument can really do.

PART TWO:
DATA DISPLAY & MENUS

When the Display Unit is turned on (by pressing the On/Off key), a start-up message that includes a copyright notice and the installed software revision number appears on the liquid crystal display. During this time, the Display Unit interrogates the attached Multiprobe to determine the configuration of the instrument. An error message will be displayed if a valid Multiprobe is not connected. (See **Section 6.2** for information on specific error messages). Other error messages may be displayed as appropriate. If all of the Multiprobe readings are not enabled, then the Display Unit will execute a Multiprobe command sequence that will result in the transmission of all available readings. All of the Multiprobe readings will remain enabled until you execute a change using a PC or terminal. No other variables or settings stored in the Multiprobe are modified at this time.

After the Display Unit has determined the configuration of the Multiprobe, a data screen will automatically appear in which readings taken from the Multiprobe are continuously displayed and updated (about once per second). The Multiprobe readings are displayed on one of two data screens selected by the Screen/Escape key. This key toggles the liquid crystal display between a Main Data Screen and an Alternate Data Screen. The Main Data Screen displays the major six water quality readings from the Multiprobe and the Alternate Data Screen shows the remaining four Multiprobe readings.

2.1 Data Display

2.1.1 Main Data Screen

The Main Data Screen shows Temperature (°C), DO (mg/L) and Depth (meters) across the top line and Specific Conductance (milliSiemens/cm), pH, and Redox (mV) across the bottom line. The front panel icons indicate the units of the default Multiprobe readings on the main display screen. The Multiprobe readings are organized as shown below in an example:

25.00	16.83	100.3
0.500	7.35	1346

If the sensor for a particular Multiprobe reading is not installed, then the Display Unit will show a dot string in that display location as follows:

25.00	16.83	100.3
0.500	7.53	....

In this example, the redox sensor was not installed in the Multiprobe at the time of manufacture.

The Multiprobe has numerous options that allow you to alter the units of the readings to fit your particular circumstances and preferences. For example, temperature can be displayed in °C (default units) or in °F. Any Multiprobe readings that have units different from those shown on the front panel are identified by a unit code that appears on the end of the data value. The unit codes for the default Main Data Screen are:

°F	**Temperature, °F**
μ℧	**Specific Conductance, microSiemens/cm**
kΩ	**Resistivity, kilohms-cm**
'	**Depth, feet**

For example, if the Multiprobe is sending temperature readings in degrees Fahrenheit and resistivity instead of conductance measurements, then the Main Data Screen will appear as shown below:

77.0°F	16.83	100.3
2.0kΩ	7.53	....

Note the unit suffix codes for the temperature and resistivity readings.

The specific conductance reading can be optionally replaced by the salinity reading that normally resides on the Alternate Data Screen. The specific conductance reading can then be found on the Alternate Data Screen. Also, the redox reading on the Main Data Screen can be interchanged with the Multiprobe Battery reading normally found on the Alternate Data Screen. These two data display customization options allow you to configure your Display Unit to minimize screen switching in most water quality measurement situations. Refer to Section 2.6.3 for details on data display customization.

2.1.2 Alternate Data Screen

The default Alternate Data Screen shows salinity and the battery readings across the top line and DO %sat and the time reading across the bottom line. The units shown on the front panel are now no longer valid and are replaced by unit codes that appear as suffixes on the Multiprobe readings. The unit codes for the default Alternate Data Screen are shown below:

ppt	**Salinity, parts/thousand**
V	**Battery, volts**
%sat	**DO, percent saturation**
g/L	**TDS, grams/liter**
:	**Time, HH:MM**

If the Multiprobe is set to take salinity readings, then as an example, the Alternate Data Screen will appear as:

0.0ppt	**12.0V**
0.0%sat	**01:59**

Note that the Multiprobe time reading is formatted as HH:MM and the seconds are not displayed. In the above example, the Multiprobe elapsed time is read as one hour and 59 minutes.

When the Multiprobe battery reading drops below 10.0 volts, then the Scout 2 adds a low battery warning symbol to the reading in the Alternate Data Screen as follows:

0.0ppt	**9.9V▯**
0.0% sat	**01:59**

The Scout 2 internal batteries should be replaced or the external battery recharged as soon as possible after the low battery warning symbol appears for optimum system performance.

Please refer to Section 2.6.3 for details on user modification of the Alternate Data Screen.

2.1.3 Data Status Screen

The Main and Alternate Data Screens do not show the calibration and compensation status characters that are normally provided by the Multiprobe. (Refer to the Multiprobe Operating Manual for details on the data status characters). This status information can be viewed on the Display Unit by pressing the downward-pointing arrow key when either of the two data display screens are active. In addition to the calibration and compensation status, the Data Status Screen shows the current power source for the Display Unit. For example, if the Display Unit is using internal batteries, and the Multiprobe depth reading is uncalibrated, then the Data Status Screen will appear as follows:

```
H20: P__ C__ S__ O__
%__ R__ D* B__ T__ □ Int
```

Note that the data status characters follow a Multiprobe reading indicator that identifies a particular Multiprobe data value. The Multiprobe reading indicators follow the notation utilized by the Multiprobe with the exception of the time reading which is denoted by the letter T on the Display Unit. (The letter T indicates the temperature reading on the Multiprobe, however, the temperature reading is always calibrated and compensated and is not included in the Data Status Screen). The Multiprobe reading indicators are as follows:

P	pH
C	Specific Conductance (or Resistivity)
S	Salinity (or TDS)
O	Dissolved Oxygen, mg/L
%	Dissolved Oxygen, % Saturation
R	Redox
D	Depth (or Level)
T	Time

The data status characters that follow the reading indicators and are summarized below:

_	Data is OK (nothing to report)
*	Data is uncalibrated
@	Data is not temperature or salinity compensated
*@	Data is uncalibrated and uncompensated
#	Data is over-ranged
x	Data probe is not installed

The status of the Scout 2 battery operation is indicated as follows:

▯ Int	Scout 2 is on internal power
▯ Ext	Scout 2 is on external power

The main or Alternate Data Screen will resume automatically if any key is pressed or if 10 seconds elapses.

For another example, the Data Status Screen shown below,

```
H20: P# C*@ S*@ O_
%_ Rx Dx B_ T_ ▯Ext
```

is interpreted as follows:

pH is over-ranged
conductance and salinity are both uncalibrated and uncompensated
dissolved oxygen, battery and time readings are OK
redox and depth sensors are not available
Scout 2 Display Unit is on external power

2.2 Menus

Due to the limited keyboard available on the Display Unit front panel, most of the keys activate multiple functions. When the Display Unit is actively displaying Multiprobe data, the Screen/Escape key will toggle between the Main and Alternate Data Screens, however, if you are in any Scout 2 System menu structure, then this same key will return you to the Data Screens. There are also four arrow keys that are used to manipulate data and menu selections or to execute auxiliary functions from the data display screens. When working in a Scout 2 System menu structure, the left and right arrow keys move the cursor between successive menu selections and the up and down arrow keys are used to change selected digits when entering a calibration value. The up and down arrow keys will also allow you to scroll up or down through a menu sequence to determine the current settings without inadvertently changing anything. The Enter key is used to fix any or all menu selections or calibration value entries.

2.3 The Menu Hierarchy

The Scout 2 System menu tree structure is outlined in *Figure 3.1*. The Display Unit has three basic or top-level menu structures that can be accessed from the front-panel keyboard. These menus allow you to set or view the Multiprobe variables, conduct calibration sequences for the Multiprobe readings, and also allow you access to some miscellaneous Scout 2 System functions. The menus are detailed in Sections 2.4 through 2.6.

2.4 Calibrate

The Scout 2 System Calibrate menu allows you to calibrate the Multiprobe readings using known standard solutions. Please refer to Part Three or the Multiprobe Operating Manual for specific details on calibrating your Multiprobe. This section describes the Scout 2 calibration and standard value entry screens used to calibrate a Multiprobe. The known solution should be placed in the Multiprobe Calibration Cup and the Multiprobe reading should be monitored on the data display screen until the reading stabilizes. The Calibrate menu can then be accessed by pressing the Calibrate key on the Display Unit front panel. The data display screen is replaced by the top-level Calibrate menu as follows:

```
      Calibrate
PCS%OARDT:  PH
```

The Calibrate menu options can be viewed by pressing the left or right arrow keys. These keys move a flashing cursor through the menu string on the left and the current selected menu option is shown on the right. The nine menu options are listed below:

P: pH
C: Specific Conductance/Resistivity
S: Salinity/TDS
%: Dissolved Oxygen (% Saturation)
O: Dissolved Oxygen (mg/L)
A: Barometric Pressure
R: Redox
D: Depth/Level
T: Time (absolute or elapsed)

Select a Calibrate menu option by moving the flashing cursor to the desired location and press the Enter key. Each of these selections are de-

See
ADDENDUM C
in the front of this manual
for latest version.

Figure 2.1 Scout 2 System Menu Tree

scribed in Sections 2.4.1 through 2.4.8. The Multiprobe temperature and battery voltage parameters are permanently set at the factory and do not require user calibration.

When you select a Multiprobe parameter to calibrate, the last available Multiprobe reading for that parameter is displayed (with the exception of DO % saturation). The displayed reading should be close to the known value of the standard solution. If the reading is correct, just press the Enter key. If not, the value can be modified using the four arrow keys as follows: the left and right arrow keys move the cursor back and forth across the digits (decimal points are automatically skipped) and the up and down arrows allow you to increment or decrement the selected digit. You can also modify the sign of the redox or depth/level readings during the calibration sequence.

When the value is correctly adjusted, use the Enter key to send the calibration value to the Multiprobe. The Display Unit asks if you really want to go ahead with the calibration; select the Y (for yes) option and press the Enter key again to proceed with the calibration. The Multiprobe has built-in checks for calibration acceptability. If the calibration value you enter is too far out of bounds, you will see a message that the calibration was out of range and the data display screen will resume. If you are unable to calibrate a Multiprobe reading, verify the quality of your standard solution and check the condition of the Multiprobe sensor. See Part Three for further details.

Calibration points are remembered by the Multiprobe even if the Display Unit is turned off. There is no need to recalibrate each time the Multiprobe is turned on, and any Multiprobe can be connected to any Display Unit without recalibration.

If you try to calibrate an Multiprobe reading for which there is no sensor installed then you will get a brief error message before the data display screen is resumed (see Section 6.2).

2.4.1 PH

Always calibrate your Multiprobe using a buffer solution near pH 7 (the pH system's zero point) before calibrating with a second buffer (the pH system's slope). Any pH value between 6.8 and 7.2 may be used for the zero setting; all other pH values may be used to calibrate the slope.

After the reading for your 7-buffer solution stabilizes, select P from the Calibrate menu to begin the pH calibration:

Calibrate PH: 7.01

The cursor will be flashing over the '7' digit in the value. If your buffer is exactly 7.00, press the right arrow key twice to place the cursor over the '1' digit. Next press the down arrow key to decrement the '1' digit to a '0' digit and press the Enter key. (Remember that the Screen/Escape key will return you to the data display screen at any time). The pH Calibrate screen will be replaced by:

Save New Cal? YN: No

Select Y and press the Enter key to set the pH system zero point and return to the data display screen.

To set the slope for the Multiprobe pH system, use the same calibration sequence as described above except replace your 7-buffer solution with a slope buffer solution (such as 9.18 or 4.02 units) and adjust the Multiprobe reading to match that of your slope buffer solution.

2.4.2 Specific Conductance/Resistance

You can calibrate either specific conductance or resistivity, or salinity or TDS, but you cannot calibrate any two of these parameters independently since they are all measured using the same sensor. If you calibrate specific conductance, then resistivity, salinity, and TDS are automatically calibrated as well. If you then calibrate, for example, salinity, then the salinity calibration is translated into a new calibration for specific conductance, resistivity, and TDS. The original specific conductance calibration is lost. So pick from those four measurements the parameter of the greatest interest and calibrate that parameter directly. Refer to Part Five for the mathematical details involved.

Monitor the specific conductance reading on the Display Unit data display screen until the reading stabilizes to the value for the standard solution in which the sensor is immersed. Select C from the Calibrate menu to begin the calibration:

Calibrate Sp Cond 0.383

The displayed reading should be close to the known value of the standard solution. Adjust the reading to be equal to the known solution value using the four arrow keys. Press the Enter key when the value is properly adjusted and select Y to the Save Cal question to complete the calibration.

Had you decided to measure resistivity instead of specific conductance by choosing resistivity over specific conductance in the Variables menu, you would now be required to enter the calibration value using the resistivity units even though the calibration menu states that you are calibrating specific conductance.

2.4.3 Salinity/TDS

You can calibrate either specific conductance or resistivity, or salinity or TDS, but you cannot calibrate any two of these parameters independently since they are all measured using the same sensor. If you calibrate specific conductance, then resistivity, salinity, and TDS are automatically calibrated as well. If you then calibrate, for example, salinity, then the salinity calibration is translated into a new calibration for specific conductance, resistivity, and TDS. The original specific conductance calibration is lost. So pick from those four measurements the parameter of the greatest interest and calibrate that parameter directly. Refer to Part Five for the mathematical details involved.

Monitor the salinity reading on the data display screen until the reading stabilizes to the value for the standard solution in which the sensor is immersed. Select S from the Calibrate menu to begin the calibration:

```
Calibrate
Salinity 40.00
```

The displayed reading should be close to the known value of the standard solution. Adjust the reading to be equal to the known solution value using the four arrow keys. Press the Enter key when the value is properly adjusted and select Y to the Save Cal question to complete the calibration.

Had you decided to measure TDS instead of salinity by choosing TDS over salinity in the Variables menu, you would now be required to enter the calibration value using the TDS units even though the calibration menu states that you are calibrating salinity.

2.4.4 Dissolved Oxygen

The two dissolved oxygen functions, DO (mg/L) and DO (% saturation) cannot be calibrated independently. Instead, choose % saturation if you wanted to calibrate to atmospheric conditions (i.e., the traditional "air cal"). The Multiprobe calculates the calibration value from a solubility table, ambient temperature, and barometric pressure.

Choose DO (mg/L) to input a special calibration (for instance, a Winkler titration value) that is different from the value that would be calculated by the Multiprobe in the % saturation mode.

Set up the dissolved oxygen (DO) sensor as required for calibration (detailed in Part Three) and wait for a stable reading. Select % from the Calibration menu to get:

```
    Calibrate
DO %SAT    760.0
```

The reading displayed opposite "DO %SAT" is the last entered barometric pressure value in millimeters of mercury. (For instance, 760 is the sea level value). Check your barometer or weather bureau to see if you need to modify this value. Be sure to convert your barometer or weather bureau readings to the proper units (mm Hg) and to compensate for your local altitude before entering the new value (see Section 5.3). Use the right and left arrow keys to select a digit to modify and the up and down arrow keys to modify the selected digit. Press the Enter key when the value is properly adjusted and select Y to the Save Cal question to complete the calibration.

Check the results of the calibration by looking at the DO % saturation reading (on the Alternate Data Screen); it should be 100.0 for the Standard membrane, or 102.5 for the Hydrolab LoFlow™ membrane (see Section 3.7). You should read Appendix 1 to see how this number correlates to DO concentration (i.e., mg/L).

Alternatively, select O from the Calibrate menu to get:

```
    Calibrate
DO mg/L   08.24
```

Now adjust the displayed DO value to match that of the calibration standard as you have measured it with a Winkler titration or another lab instrument. Press the Enter key when the value is properly adjusted and select Y to the Save Cal question to complete the calibration.

This calibration sequence uses the barometric pressure value entered using the barometric pressure calibration sequence described in Section 2.4.5. Be sure to check this value before conducting the DO concentration calibration.

2.4.5 Barometric Pressure

You can change the barometric pressure value that is used to correct the dissolved oxygen readings to more closely match the current environmental conditions. The default barometric pressure value is fixed to 760.0 (sea level) millimeters of mercury. Select A from the Calibration menu to modify this value (default is the sea level or 760.0 value):

```
Calibrate
Atm Press    760.0
```

The reading displayed opposite "Atm Press" is the last entered barometric pressure value in millimeters of mercury. Check your barometer or weather bureau to see if you need to modify this value. Be sure to convert your barometer or weather bureau readings to the proper units (mm Hg) and to compensate for your local altitude before entering the new value (see Section 5.3). Use the right and left arrow keys to select a digit to modify and the up and down arrow keys to modify the selected digit. Press the Enter key when the value is properly adjusted and select Y to the Save Cal question to complete the calibration.

2.4.6 Redox

To calibrate the Multiprobe redox reading (also known as ORP or Eh), select R from the Calibrate menu to begin:

```
Calibrate
Redox    500
```

The reading displayed opposite "Redox" is the last available Multiprobe redox reading in millivolts. Note that redox readings are inherently slow to equilibrate so allow extra time for this calibration. When you need to modify this value to match the known value of your redox solution then use the right and left arrow keys to select a digit to modify and the up and down arrow keys to modify the selected digit. Press the Enter key when the value is properly adjusted and select Y to the Save Cal question to complete the calibration.

2.4.7 Depth/Level

To calibrate the Multiprobe depth or level sensor, place the Multiprobe at a known depth (you can use "zero" depth at or near the water surface) and select D from the calibrate menu:

```
  Calibrate
Depth   000.0
```

The reading displayed opposite "Depth" is the last available Multiprobe depth or level reading. If you need to modify this value to match the known location of your Multiprobe then use the right and left arrow keys to select a digit to modify and the up and down arrow keys to modify the selected digit. Press the Enter key when the value is properly adjusted and select Y to the 'Save Cal' question to complete the calibration.

Had you decided to measure depth or level in feet instead of meters by choosing feet over meters in the Variables menu, you would now be required to enter the calibration value in feet.

2.4.8 Time

Select T from the Calibrate menu to modify the Multiprobe time function:

```
  Calibrate
Time    122435
```

The reading displayed opposite "Time" is the last available Multiprobe time reading. If you need to modify this value then use the right and left arrow keys to select a digit to modify and the up and down arrow keys to modify the selected digit. Press the Enter key when the value is properly adjusted and select Y to the Save Cal question to complete the calibration.

Use the military time format when setting the Multiprobe time; for example, if you want to set the time to 5:30 in the morning then you would adjust the displayed time value to 053000. Numbers greater than 59 in the minutes or seconds positions or numbers greater than 23 in the hours position will generate a "CAL out of Range" message. Be sure to check the data display screen (Alternate Data Screen) to make sure that the time reading is correct.

Note that the Display Unit does not display the "seconds" portion of the Multiprobe time value on the Alternate Data Screen, but that you can calibrate the time reading down to the "seconds" resolution.

2.5 Variables

The Multiprobe has a large number of user modifiable features (known as variables) that allow adaptation to various measurement situations. These variables are stored in a non-volatile fashion in the Multiprobe so that they are retained even if the Display Unit is turned off. The Multiprobe variables can be accessed in the Scout 2 System using the Variables menu. The Variables menu is accessed by pressing the Variables key on the Display Unit front panel. The data display screen is replaced by the top-level Variables menu as follows:

```
  Variables
TCOD: Temperature
```

The Variables menu options can be viewed by pressing the left or right arrow keys. These keys move a flashing cursor through the menu string on the left and the current selected menu option is shown on the right. The four Variables menu options are listed below:

T: Multiprobe Temperature variable
C: Multiprobe Specific Conductance/Resistivity variables
O: Multiprobe Dissolved Oxygen variables
D: Multiprobe Depth variables

Select a Variables menu option by moving the flashing cursor to the desired location and press the Enter key. Each of these selections have one or more submenus that are described in Sections 2.5.1 through 2.5.4.

2.5.1 Temperature

Select T from the Variables menu to enter the Temperature Variable menu:

```
   T Variable
CF: °F
```

The flashing cursor is positioned to the current Multiprobe setting (degrees Fahrenheit in this case). Move the cursor to C if you wish to change the Multiprobe temperature units to degrees Centigrade or to F if wish the temperature units to be in degrees Fahrenheit. Press the Enter key to store the new setting in the Multiprobe and return to the data display mode. Remember that if you do not want to change the temperature variable at this point, press the Screen/Escape key or the down arrow key to return to the data display mode. Any selected menu option will then be discarded. Pressing the up arrow key will return you to the Variables menu for another selection.

2.5.2 Specific Conductance/Resistivity

The Specific Conductance/Resistivity Variables menus will lead you through a series of five variables that you can choose to modify or skip. Again, the flashing cursor is positioned to the current Multiprobe settings. The current variable settings can be viewed by using the down arrow key. Pressing the down arrow key at the last or fifth variable will return you to the data display mode without any changes being performed. Pressing the up arrow key from the first variable position will return you to the Variables menu for a new selection. Any desired variable modifications must be fixed using the Enter key on each of the five variables in this menu. Pressing the Screen/Escape key at any time will return you to the data display screen.

Selecting a C from the Variables menu will produce the following submenu:

```
  C Variables
CR: Resistivity
```

Select C if you wish to measure specific conductance instead of resistivity. Select R otherwise. Press the Enter key to fix the new selection and to continue to the next variable:

C Variables
MU: MicroSiemens

Select M if you want your data reported in milliSiemens/cm or a U if you need microSiemens/cm. Press Enter to continue:

C Variables
FS: Salt Water

Select F if your Multiprobe is equipped with a freshwater Cell Block or select S if it has a saltwater Cell Block (Section 3.4). Press Enter to continue:

C Variables
TS: TDS

Select S if you wish to display salinity instead of TDS. Select T otherwise. Press Enter to continue:

C Variables
UT: Temp Comp

Select U if you want your specific conductance/resistivity and salinity/TDS readings to be reported without reference to 25°C. Select T otherwise. Press Enter to set all of these specific conductance/resistivity variables and return to the data display mode.

You might have noticed that the Multiprobe has an additional specific conductance/resistivity variable that controls the ranging of the readings. This variable is not included in the Display Unit and cannot be modified using the Scout 2 System. This variable is mainly used to modify the specific conductance/resistivity data for use with data collection platforms and certain types of data recorders. This variable remains at the setting previously stored in the Multiprobe. Consult the Multiprobe Operating Manual for the details of this variable.

2.5.3 Dissolved Oxygen

The Dissolved Oxygen Variables menu will lead you through a series of two variables that you can choose to modify or skip. Again, the flashing cursor will be positioned to the current Multiprobe settings. The current variable settings can be viewed by using the down arrow key. Pressing the down arrow key at the last or second variable will return you to the data display screen without any changes being performed. Pressing the up arrow key from the first variable position will return you to the Variables menu for a new selection. Any desired variable modifications must be fixed using the Enter key on each of the two variables in this menu. Pressing the Screen/ Escape key at any time will return you to the data display screen.

Select O from the Variables menu to modify or view the Multiprobe DO variables:

```
O Variables
SL: LOFLOW
```

Select S if you are using a Standard membrane, or select L if you are using a LoFlow membrane and its helper software (see Section 3.7 or Appendix 1 for more explanation). Press Enter to continue:

```
O Variables
SU: Salt Uncomp
```

Select S if you want your DO (mg/L) readings to be compensated for the effect of sample salinity or select U otherwise. Press Enter to set these variables and return to the data display screen.

2.5.4 Depth/Level

The Depth/Level Variables menu will lead you through a series of two variables that you can choose to modify or skip. As before, the flashing cursor is positioned to the current Multiprobe settings. The current variable settings can be viewed by using the down arrow key. Pressing the down arrow key at the last or second variable will return you to the data display mode without any changes being performed. Pressing the up arrow key from the first variable position will return you to the Variables menu for a new selection. Any desired variable modifications must be fixed using the Enter key on each of the two variables in this menu. Pressing the Screen/ Escape key at any time will return you to the data display screen.

Select D from the Variables menu to modify or view the Multiprobe depth/level variables:

```
D Variables
MF: Feet
```

Select M if you want your depth or level readings displayed in meters; select F if you work in feet. Press Enter to continue:

```
D Variables
DL:  Depth
```

Select D if your Multiprobe is equipped with a depth transducer (range: 0 to 100 meters). Select L if your Multiprobe is equipped with a level transducer (range: 0 to 10 meters). The transducer type is printed on the Multiprobe's label. Press Enter to set these two variables and return to the data display screen.

2.6 System

The Scout 2 System menu is a collection of functions that allow you some data display options as well as viewing of your Multiprobe Label contents and software revision. The Scout 2 System menu is invoked from a data display screen by pressing the up-arrow key. The data display screen is replaced by the top-level System menu:

```
System Menu
LVSC:     Label
```

The System menu options can be viewed by pressing the left or right arrow keys. These keys move a flashing cursor through the menu string on the left and the current selected menu option is shown on the right. The four System menu options are listed below:

L: Label - Show the current Multiprobe Label contents
V: Version - Show the Multiprobe and Scout 2 software revision
S: Swap - User customization of the data display screens
C: Contrast - Modify the Scout 2 liquid crystal display contrast

Select a System menu option by moving the flashing cursor to the desired location and press the Enter key. Each of these selections have one or more submenus that are described in Sections 2.6.1 through 2.6.4.

2.6.1 Label

Select L from the System menu to display the contents of your Multiprobe Label. The Label typically contains your Multiprobe serial number. The default Label for a Multiprobe is shown below:

Label
NO LABEL

The Label is displayed for about 5 seconds (or until you press any key) before the data display screen is resumed.

The Scout 2 does not have any provision to allow you to alter the contents of your Multiprobe Label. Please consult your Multiprobe Operating Manual for further details.

2.6.2 Version

Select V from the System menu to display the current software revision numbers for your Scout 2 System. Please note these software revision numbers when you need to contact Hydrolab concerning your Scout 2 System. This function returns the revision number for the Display Unit software and the revision number for the particular H20 Multiprobe that is connected:

SCOUT 2:	1.00
H20:	1.02

The revision numbers are displayed for about 5 seconds (or until you press any key) before the data display screen is resumed.

2.6.3 Swap

The Swap function allows you to customize your Scout 2 data display screens by moving the Multiprobe salinity reading from the Alternate Data Screen to the Main Data Screen where it would replace the Multiprobe specific conductance reading. The specific conductance reading is then moved to the old salinity position on the Alternate Data Screen. The Multiprobe battery reading can also be moved from the Alternate Data Screen to the redox reading position on the Main Data Screen. The redox reading can then be found on the Alternate Data Screen in the old battery value position. Since the units of the swapped Multiprobe readings will no longer match the Display Unit front panel icons, unit codes will be added to the readings as follows:

s	Salinity on Main Data Screen (ppt)
g	TDS on Main Data Screen (g/L)
mv	Redox on Alternate Data Screen (millivolts)
m℧	Specific Conductance (milliSiemens/cm) on Alternate Data Screen
kΩ	Resistivity on Alternate Data Screen (kilohms-cm)
V	Battery on Main Data Screen (volts)
µ℧	Specific Conductance (microSiemens/cm) on either data screen

Select S from the System menu to begin the Swap function:

```
      SAL on Main
YN:   NO
```

Use the right arrow key to select Y for yes and press the Enter key:

```
      BATT on Main
YN:      NO
```

Use the right arrow key to select Y for yes and press the Enter key to execute the changes and return to the data display screens. Note that you have the option of executing one or both of the display modifications. Remember that if you press the Screen/Escape key before you press the Enter key you will exit the System menu without any changes.

The modified data display screens will remain in effect until you change them again or if the Display Unit loses all power for longer than 25 minutes.

2.6.4 Contrast

The Contrast function allows you to adjust the contrast (brightness) of the Display Unit liquid crystal display to compensate for ambient air temperature or viewing angle effects. As the ambient temperature gets colder you may find that increasing the display contrast will improve the readability of the display. You may also need to adjust the contrast to improve the brightness of the display based on the position of the display when you observe the readings. Some experimentation here will allow you to observe the effect of viewing angle on display brightness. The default contrast setting (as shipped from the factory) is optimized for most measurement circumstances but if you would like to modify the display contrast then select C from the System menu:

```
       Set Contrast
MinII II II II II II II. . . .Max
```

The display contrast will increase or decrease by one step each time you press the right or left arrow key, respectively. The bar graph display shows you the relative amount of adjustment. You might notice that you can decrease the contrast to the point where the display completely disappears; just use the right arrow key to increase the contrast or press the Screen/Escape key to return to the data display screens without changing the contrast.

When you find the optimum contrast setting, press the Enter key to fix the new setting. You are first asked if you really want to change the contrast as follows:

```
   Set Contrast
YN:  No
```

Select Y (for yes) and press the Enter key again to complete the contrast adjustment and return to the data display screen. The display contrast will remain in effect until you change it again or if the Display Unit loses all power for longer than 25 minutes.

2.7 Helpful Hints

Remember that any time you want to exit any Scout 2 System menu without changing any settings, just press the Screen/Escape key. You will be returned automatically to the Main or Alternate Data Screen (whichever screen was active when you entered the menu) as if you never entered the menu at all. You must use the Enter key to complete any menu activity or calibration value adjustment.

You must also keep your Multiprobe sensors clean and well maintained. Calibration of a neglected sensor is in most cases a waste of time. Remember to check the Data Status Screen (Section 2.1.3) and the data display screen to confirm that the new calibration value is in effect.

PART THREE: MAINTENANCE and CALIBRATION

3.1 Caring for Your Multiprobe

Please read your multiprobe's operating manual for detailed instructions on maintenance and calibration.

Note: Remember that the calibration points for a Scout 2/multiprobe system are stored in the multiprobe. This allows one display unit to calibrate several multiprobes if those multiprobes are to be used later without a display unit (for instance, unattended logging, or attached to a PC). It also means that any multiprobe can be used with any display unit, without recalibration. In other words, the multiprobes are interchangeable.

3.2 Changing the Scout 2 Display Unit Internal Batteries

The display unit internal battery pack consists of a plastic holder containing 10 "AA" size batteries. You should generally use alkaline type batteries to provide the longest service life. When the low battery indicator becomes activated (when the multiprobe battery reading drops below 10.0 volts), you should begin making plans to change the internal batteries (or recharge your external battery). The internal battery pack (when using alkaline cells) will operate your display unit and multiprobe with an attached stirrer continuously for at least 11.5 hours.

To change the internal batteries, begin first by disconnecting the underwater cable from the display unit and remove the display unit case from the bottom of the rubber boot. Use a flat-blade screwdriver to loosen the four screws on the top of the case. Loosen each screw a few turns then proceed to another screw to avoid undue stress on the case top. When all four screws are loose, carefully lift the top straight up and note the wiring harness that is connected. The wiring harness attaches to a printed circuit board (that is attached directly to the case top) using a latching connector. Push both retaining ears of the connector upwards to eject the wiring harness and free the case top.

The plastic battery holder is mounted in the bottom of the display unit case (under the rubber insulating material) using Velcro™ material. Remove the expired batteries and install 10 fresh "AA" alkaline batteries being very sure to note the polarity markings on the battery holder. Be certain that all batteries are securely seated in the holder and place the rubber insulating material on top of the battery holder.

Reconnect the wiring harness to the printed circuit board by firmly pressing the connector in until the latching ears engage. Carefully position the case top over the case bottom and first making sure that the wiring harness will not be damaged, begin to tighten the four screws in the case top. Tighten each screw a few turns and then proceed to the next screw until all are tight.

Replace the rubber boot by inserting the display unit case from the bottom and working the rubber boot around the case. Connect the multiprobe and verify proper operation. The battery reading from the multiprobe should now be about 15 volts.

When using an external power source for an extended length of time, you should always remove the internal batteries so that they will not be discharged. An error message will appear if you attempt to use an external power source when you have internal batteries installed. See Section 6.2.

PART FOUR: DEPLOYMENT

4.1 Deployment in Open Waters

Protect the display unit from mechanical shock and excessive vibration.

4.2 Using the Stirrer

The same power utilized by the Scout 2 Display Unit powers the multiprobe, as well as the stirrer; so you might wish to have a spare battery handy if you are on a long field trip with extended stirrer use. If your measurements do not require the stirrer, be sure to disconnect it from the cable to extend the battery life. Don't forget to insert the dummy plugs into the two open connectors to prevent water damage.

4.3 Pressure and Temperature Extremes

The Scout 2 Display case is water-tight, but not rated for submersion. The display unit has an operating temperature range of -5°C to 50°C (about 23°F to 122°F). Exposure of the display unit to temperatures outside of this range might result in mechanical damage or faulty electronic performance. The latter may be very subtle.

4.4 Performance Measurement and Improvement

This manual is designed to best meet the needs of the "typical" field practitioner. However, if you have an application that demands increased performance or operation under unusual circumstances, Hydrolab Corp. is willing and able to help. **Just call 800-949-3766** or **512-255-8841**. Hydrolab's staff of engineers and application experts will be more than happy to share with you their years of experience in helping operators get good data under demanding field conditions. Just call.

PART FIVE: TECHNICAL NOTES

5.1 Dissolved Oxygen Temperature and Salinity Corrections

There are five components to the dissolved oxygen concentration (i.e, mg/l) reading: the "raw" sensor reading, a scale factor, the membrane temperature correction, the solubility temperature correction, and the salinity compensation. The raw reading is a function of the DO cell itself, and is related to the sensed partial pressure, not concentration, of oxygen dissolved in the sample. The scale factor is set by the operator during calibration. The membrane temperature correction is determined experimentally for each type of membrane. The solubility temperature function corrects for effect of temperature on the solubility of oxygen in water. The salinity function corrects for the effect of salinity on the solubility of oxygen in water.

The function used for membrane temperature correction at a temperature T (°C) for the Standard Membrane (1-mil Teflon) is:

$$F(T) = 2.2513\,(10^{-7})\,T^4 - 3.3116\,(10^{-5})\,T^3 + 2.2366\,(10^{-3})\,T^2 - 9.3778\,(10^{-2})\,T + 2.3761$$

The function used for membrane temperature correction at a temperature T (°C) for the Hydrolab LoFlow Membrane is:

$$F(T) = 7.6233\,(10^{-7})\,T^4 - 1.2322\,(10^{-4})\,T^3 + 8.2111\,(10^{-3})\,T^2 - 2.8240\,(10^{-1})\,T + 4.5557$$

In both cases, the raw DO signal is multiplied by F(T) to produce the temperature-corrected reading, so divide the DO reading by F(T) to un-correct for temperature.

The function used to convert DO % Sat to salinity-uncompensated DO mg/L is:

$$FC(T) = 100/(7.2541\,(10^{-9})\,T^5 - 5.1387\,(10^{-7})\,T^4 + 9.8316\,(10^{-6})\,T^3 + 5.2276\,(10^{-4})\,T^2 + 0.19665\,T + 6.8356)$$

The DO % Sat reading is dividedby FC(T), so multiply he DO mg/L reading by FC(T) to uncompensate. The data used to generate this polynomial comes from the oxygen solubility data in the 1985 Standard Methods.

The function used to salinity-compensate DO (to "true" DO) for a specific conductance C (mS/cm) at a temperature T (°C) is:

$$F(C) = 1 - C(3.439\,(10^{-3}) + 0.361/(22.1 + T)^2)$$

The raw DO signal is multiplied by F(C) to produce the salinity-compensated reading, so divide the DO reading by F(C) to un-correct for salinity. The data used to generate this polynomial comes from the oxygen solubility vs. chlorinity data in the 1985 Standard Methods.

Note that DO % saturation is not a function of solubility, and so has neither a salinity correction nor temperature correction for solubility.

5.2 The LoFlow Membrane Flow Optimization Factor

When sample flow is stopped (i.e, reduced to about one cm per minute), it is the nature of Hydrolab's LoFlow Membrane to fall to about 95% of a full-flow reading. The same sensor with a Standard Membrane (1-mil Teflon) will fall to about 50% of a full-flow reading under the same conditions (full-flow is taken to be 25 cm/sec or greater). To optimize the LoFlow sensitivity of -5% to ±2.5% (due to flow), the LoFlow readings are automatically boosted by 2.5%.

This means that if a sample of water is at exactly 8 mg/l DO concentration, the LoFlow would read 8.2 mg/l, while the Standard would read 8. If flow was cut to near zero (i.e, one cm/minute), the LoFlow would read 7.8, while the Standard would read about 3.2.

5.3 Dissolved Oxygen Altitude-Pressure Function

When you calibrate DO, you must input the local barometric pressure, BP, in millimeters of mercury. You can estimate BP with this expression:

$$BP = 760 - 2.5(A/100)$$

"A" is your local altitude above sea level in feet.

If you are using the BP given by your local weather bureau, remember that their numbers are corrected to sea level, and you must use BP', the un-corrected atmospheric pressure:

$$BP' = BP - 2.5(A/100)$$

5.4 Specific Conductance

5.4.1 Specific Conductance Temperature Standardization

Conductivity is a measure of a water's ability to conduct electricity, and therefore a gross measure of the water's ionic activity. Generally, the higher a water's concentration of ionized impurities, the higher its conductivity. However, the capacity of those impurities to conduct electricity varies with temperature. The conductivity of a water sample heated from 15°C to 35°C changes greatly during the heating.

On the other hand, specific conductance is the conductivity measured when a water's temperature is fixed at 25°C. Unlike conductivity readings, specific conductance readings are easily compared if the readings are made at different temperatures, for instance in a lake during various seasons.

The function (based on 0.01N KCl) used to standardize conductivity to 25 °C for the temperature, T (°C), when the Freshwater cell block is used is:

$$F(T) = 1.4326\,(10^{-9})\,T^5 - 6.0716\,(10^{-8})\,T^4 - 1.0665\,(10^{-5})\,T^3 + 1.0943\,(10^{-3})\,T^2 - 5.3091\,(10^{-2})\,T + 1.8199$$

The raw signal (i.e, conductivity) is multiplied by F(T) to produce the temperature-standardized reading (i.e, specific conductance), so divide the specific conductance reading by F(T) to de-standardize for temperature (i.e, produce the conductivity reading).

The function (based on seawater) used to standardize conductivity to 25 °C for the temperature, T (°C), when the Saltwater cell block is used is:

$$F(T) = 1.2813\,(10^{-11})\,T^7 - 2.2129\,(10^{-9})\,T^6 + 1.4771\,(10^{-7})\,T^5 - 4.6475\,(10^{-6})\,T^4 + 5.6170\,(10^{-5})\,T^3 + 8.7699\,(10^{-4})\,T^2 - 6.1736\,(10^{-2})\,T + 1.9524$$

The raw signal (i.e, conductivity) is multiplied by F(T) to produce the temperature-standardized reading (i.e, specific conductance) so divide the specific conductance reading by F(T) to de-standardize for temperature (i.e, produce the conductivity reading).

These corrections are based on reference data over the 0 to 30°C range (from USGS Water Supply Paper 2311). An optimization of the characteristics of both salt and fresh waters is used for temperatures outside the 0 to 30°C range. If you need a more specific correction, then record your data as uncompensated conductivity (Section 2.6.2). Later, you can apply your own temperature correction to the data (for instance, in a spreadsheet).

Because resistivity is calculated from the temperature-corrected conductivity (i.e, specific conductance) reading, resistivity also has the above correction, as do salinity and total dissolved solids (TDS).

5.4.2 Specific Conductance to Salinity Conversion

The function used to convert specific conductance, C, to salinity, S, is:

$$S = 5.9950\,(10^{-8})\,C^4 - 2.3120\,(10^{-5})\,C^3 + 3.4346\,(10^{-3})\,C^2 + 5.3532\,(10^{-1})\,C - 1.5494\,(10^{-2})$$

This relationship is taken from the USGS Water Supply Paper 2311. Note that while any specific conductance can be converted to salinity, salinity is defined only for mild dilutions and concentrations of seawater (say, the 30 to 40 ppt salinity range).

Note that salinity, unlike specific conductance, the parameter from which salinity is calculated, is not actually "temperature compensated". A part-per-thousand is a part-per-thousand, no matter what the temperature. However, the above conversion algorithm only works for conductivity readings that have been corrected to 25°C (i.e, specific conductance readings).

If you have more specific information on your particular samples, then record conductivity instead of salinity and, with a spreadsheet, calculate salinity from those readings.

5.4.3 Specific Conductance to Resistivity Conversion

Resistivity is simply the inverse of specific conductance. For example, the resistivity corresponding to 100 microSiemens/cm (0.1 milliSiemens/cm) is 10.0 K ohm cm.

5.4.4 Specific Conductance to Total Dissolved Solids (TDS) Conversion

TDS is calculated from specific conductance as:

$$TDS = C(0.640)$$

where TDS is total dissolved solids in K mg/l (i.e, g/l) and C is specific conductance in mS/cm (from Water Chemistry, by Snoeyink and Jenkins).

If you have more specific information on your particular samples, then record specific conductance instead of TDS and, with a spreadsheet, calculate TDS from the specific conductance readings.

5.4.5 Correcting Depth for Specific Conductance

The density of water, and hence its ability to "create" pressure, increases with specific conductance. Therefore, if a depth transducer is calibrated for fresh water, the depth reading must be reduced for measurements made in salt waters. The following correction is used for depth (and level) readings:

$$F(C) = 1 - 0.03(C/52)$$

C is the measured specific conductance in mS/cm. The raw depth readings are multiplied by F(C) to produce the displayed reading. In effect, no correction is made at zero specific conductance, and readings are reduced by three percent at 52 mS/cm, the specific conductance of sea water.

5.4.6 Measuring pH in Very Low Specific Conductance Waters

If you make pH or conductivity measurements in water whose conductivity is less than 0.2 milliSiemens/cm, please contact Hydrolab. Making measurements in very dilute solutions is a whole different ballgame, especially for pH. See the "*Application Note on pH Measurements*" located at the back of your multiprobe Operating Manual.

5.5 Turbidity

5.5.1 Measurement Principle

The ISO-7027 specification calls for a nephelometric detector at 90 degrees from an infrared light source of 860 nm. Hydrolab's turbidity sensor, when operated in nephelometric mode, meets all these specifications except the light source is at 880 nm.

The ratio mode adds a transmissive correction to eliminate the "blinding out" phenomenon common in nephelometric instrumentation at high turbidities.

Selection of mode is highly dependent upon your data requirements, adherence to any measurement specifications, and your primary range of measurement.

5.5.2 Ambient Light

The multiprobe measures the sensor responses when the light source is on and when it is off. The difference between the on and off responses is used to eliminate the effects of ambient light and provide the turbidity measurements.

But there is a limit the to the amount of ambient light which can be rejected. If the ambient light "saturates" the sensors, then the on and off responses to the light source will be nearly the same. Incorrect turbidity values are produced. The multiprobe can detect when the ambient light is causing questionable turbidity data. When this condition is detected, a "?" is printed next to the turbidity data value.

The maximum ambient light threshold is equivalent to the amount of light reaching the sensor at a 1m submersion in "turbidity-free" water at full sunlight. At 1m deep, infrared light detected by the sensor is attenuated to 1%.

5.5.3 Light Source Variation

The light source output varies tremendously from part to part and over temperature. A third sensor was added to measure the light output and normalize the nephelometric and transmissive sensor responses.

Additionally, this third sensor allows the multiprobe to detect a faulty light source. The photodiode measures the light source output to insure proper operation. If the light source output becomes too low, a "?" is printed next to the turbidity data. To determine if the "?"' is caused by ambient light or a faulty light source, shield the sensor from ambient light. If the "?" disappears, then the ambient light is too high. Otherwise, please contact Hydrolab Customer Service.

5.6 Performance Measurement and Improvement

This manual is designed to best meet the needs of the "typical" field practitioner. However, if you have an application that demands increased performance or operation under unusual circumstances, Hydrolab Corp. is willing and able to help. Just call 800-949-3766 or 512-255-8841. Hydrolab's staff of engineers and application experts will be more than happy to share with you their years of experience in helping operators get good data under demanding field conditions. Just call.

PART SIX: TROUBLESHOOTING

NOTE: For troubleshooting the operation of the multiprobe, see your multiprobe's operating manual.

6.1 General

1) Display Unit display is blank:

a) Are all connectors mated properly?

b) If you are using an external battery, is the voltage between 8.5 and 13 volts?

c) If you are using the Scout 2 internal batteries, is the voltage between 10.0 and 16.0 volts?

d) Did you press the On/Off switch? Try it again.

2) Parameter reading(s) are missing or incorrect:

a) Is your multiprobe equipped with the sensor for that parameter? (••••• means that the multiprobe does not have that specific sensor.)

b) Are you looking at the correct screen (Main or Alternate) for the parameter sought?

c) Check the Variables menu to make sure all variables are set as expected.

3) A calibration is not accepted:

a) Are you sure of the value of your calibration standard?

b) Are the sensors properly serviced? See Part Three of your multiprobe's operating manual.

c) Did you enter the value of your calibration standard correctly, and in the proper units?

4) Dissolved Oxygen readings are too low to calibrate, and/or pH and/or redox readings are very high or very low:

a) Are you sure of the value of your sample solution?

b) If you are using the multiprobe's internal batteries, are they fresh? See Section 3.11 of your multiprobe's operating manual.

c) Are the sensors properly maintained? See Part Three of your multiprobe's operating manual.

d) Check the Variables menu to make sure that the type of membrane material specified is correct (Standard or LoFlow).

5) Specific conductance, temperature, and/or depth readings seem wrong:

a) Are the sensors maintained and calibrated properly? See Part Three of your multiprobe's operating manual.

b) Are you sure of the units being printed? For instance, are the depth readings in feet or meters? See Section 2.5 of this manual.

6.2 Scout 2 Display Unit Error Messages

Your Scout 2 Display Unit contains a set of self-diagnostics that can help you identify a problem. Some of the errors are fatal (i.e., the message will appear for about 3 seconds and the display unit will turn itself off). If you get one of these messages, try to turn the display unit back on again (press the On/Off key) to be sure that the error is consistent. The remainder of the error messages will appear for about three seconds before the previous data display screen is resumed. These can be caused by operator error.

Be sure to note the occurrence of any of these error messages when contacting the Hydrolab Service Department.

"Keyboard Error" During power up (when the On/Off key is pressed) the keyboard is checked for stuck keys. If one or more keyboard keys are pressed or stuck in a pressed position then this message will appear and the display unit will shut off after about 3 seconds.

"Ext Power is Applied, Remove Int Batteries" When the On/Off key is pressed, internal or external Scout 2 System battery operation is verified. If external power is connected with the internal batteries installed then this message will appear for 3 seconds before the display unit begins displaying data (see Section 3.12).

"Sonde not Responding" If the Sonde (multiprobe) is not functioning or not connected when the On/Off key is pressed, then this message will appear and the unit will shut off after about 3 seconds. Usually this error is caused by open cable wiring or insufficient battery voltage.

"Sonde Hardware Error" This message is shown if the multiprobe reports a hardware error. This message will remain until the error condition clears or the display unit is turned off.

"Sonde Response Error" This message is displayed if an unexpected multiprobe response occurred during the power up sequence. This might be caused by an intermittent cable failure or insufficient battery voltage. This message will appear for about 3 seconds and the display unit will then shut off.

"Unable to Enter Menu" The display unit is unable to access any of the multiprobe menu tree structure. This would be a rare error but might be caused by an intermittent failure that interrupted data synchronization between the display unit and the multiprobe. This message will appear for about 3 seconds and the display unit will then shut off.

"Sonde not Supported" The current Scout 2 software cannot display data from this instrument due to incompatibilities. This message will appear for about 3 seconds and the display unit will then shut off. This message is included for future Hydrolab instrumentation.

"CAL out of Range" An invalid calibration value has been entered and ignored by the multiprobe. The previous data display screen will resume after about 3 seconds.

"PARAM not available" An attempt to calibrate a multiprobe parameter that does not have a data probe installed. The previous data display screen will resume after about 3 seconds.

PART SEVEN
LOGGING

The DataSonde 3

Hydrolab offers the DataSonde 3 Multiprobe Logger for data logging applications that require a submersible logger. The DataSonde 3 is essentially identical to an H20, except it has a logger and battery supply built into the multiprobe housing. Programming and data recovery are done with a personal computer; logged data can be transferred directly to a personal computer, and then into spreadsheets, data bases, word processors, graphics packages, etc. Please call Hydrolab for specific information.

Logging with a Personal Computer

Almost any personal computer can communicate with, and accept data from Hydrolab multiprobes' standard RS-232 output. With software packages available from third-party software producers, this data can then be logged onto floppy or hard disc for later use. The software can be customized to your needs.

There are also several third-party field loggers available that interface to Hydrolab multiprobes via RS-232. Please call Hydrolab for specific information.

Logging with Analog Voltage Output

Hydrolab offers an Analog Converter that converts the Hydrolab multiprobe digital output to parallel voltages or currents. This allows a Hydrolab multiprobe to be used with virtually any logger, controller, or SCADA system that accepts analog inputs, while retaining the advantages of RS-232 for long cable runs. Please call Hydrolab for specific information.

APPENDIX 1

Technical Data

Scout® 2 Display Battery Current Consumption

(@ 12VDC input)

standby (Display Unit off)	26µA, 85µA max
active with H20® Multiprobe (Display Unit on)	80mA, 125mA max
active with H20 Multiprobe (and Stirrer)	120mA, 145mA max

ADDITIONAL INFORMATION

R.G.A. No. ______________

Date Shipped to Hydrolab ______________

HYDROLAB

SERVICE MEMORANDUM

The following information is requested in order to process your order for warranty or non-warranty service. Please include this form, fully completed, with your return shipment.

Customer Contact Name ______________________________

Customer Phone Number ______________________

Address for return shipment of repaired equipment ______________________________

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City State Zip

Address for billing (or purchase authority) for repair charges not covered by warranty ______________________________

____

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____

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City State Zip

WARRANTY INFORMATION – please check the appropriate box and furnish requested materials:

- ☐ *Sales Warranty* Attach copy of Invoice or Proof-of-Purchase
- ☐ *Service Warranty* Attach copy of previous R.G.A.
- ☐ *Non-Warranty* Method of payment: ☐ VISA/MC ☐ P.O. No. ______________ ☐ Other ______________________________

SHIPPING INSTRUCTIONS – Please refer to the instructions given under SERVICE AND WARRANTY (found in the back of your instrument Operating Manual) before packaging your instrument for shipment to Hydrolab.

Note: Please install dummy plugs and fill storage cups about 2/3 full of water prior to packaging.

Address each carton to:

HYDROLAB CORPORATION
SERVICE DEPARTMENT
12921 BURNET ROAD
AUSTIN, TX 78727 U.S.A.

Please clearly mark each box with: **R.G.A. No.** ______________
Carton # ______ **of** ______

Please describe equipment problem on the reverse side of this memorandum.

HYDROLAB CORPORATION P.O. Box 50116 • Austin, Texas 78763 • USA
Telephone (512) 255-8841 • FAX (512) 255-3106

INVENTORY OF EQUIPMENT BEING RETURNED

Model No. and Description	Serial No.

Description of Problem(s) or Explanation

R.G.A. No. ______________

Date Shipped to Hydrolab ______________

HYDROLAB

SERVICE MEMORANDUM

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City State Zip

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Customer Phone Number ____________

Address for return shipment of repaired equipment ____________

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City State Zip

Address for billing (or purchase authority) for repair charges not covered by warranty ____________

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City State Zip

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