Model
DH-21

WATERLOG®
SERIES

Owner's Manual

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Owner's Manual

NOTICE

Document Number: DH21001, DH21002
Document Authors: James Cook, Terrell Fletcher
Revision: 1.5

75 West 100 South
Logan, UT 84321 USA
Phone: (435) 753-2212
Fax: (435) 753-7669

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User Agreement/ *WATER*LOG® Warranty

1. NATURE OF THE PRODUCT

This agreement accompanies a pressure measuring system comprising micro-coded circuitry and other electronic equipment sealed in an enclosed housing, and packaged together with written instructional materials. The packaged electronic circuitry and instructional materials herein are collectively referred to as the "PRODUCT." The PRODUCT is made available from DESIGN ANALYSIS ASSOCIATES, INC., of 75 West 100 South, Logan, Utah 84321 (hereinafter referred to as "DESIGN ANALYSIS"), and contains information and embodies technology that is confidential and proprietary to DESIGN ANALYSIS, and the availability and use of the PRODUCT is extended to you, the USER, solely on the basis of the terms of agreement which follow.

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Opening the package which encloses the accompanying PRODUCT indicates your acceptance of the terms and conditions of this agreement and constitutes an acknowledgment by you of the confidential and proprietary nature of the rights of DESIGN ANALYSIS in the PRODUCT.

3. DUTIES OF YOU, THE USER

In consideration for the access to and use of the PRODUCT extended to you by DESIGN ANALYSIS and to protect the confidential and proprietary information of DESIGN ANALYSIS, USER agrees as follows:

(A) USER agrees that they will not open the sealed housing of the PRODUCT, and that they will take all necessary precautions to prevent their employees, agents, sub-contractors and resellers from doing so.

(B) USER agrees that they will not remove from the exterior of the housing of the PRODUCT any warnings against opening or notices of proprietary interest placed thereon by DESIGN ANALYSIS, and that they will take all necessary precautions to prevent their employees, agents, sub-contractors, and resellers form removing such markings therefrom.

(C) USER agrees to treat the PRODUCT with the same degree of care as USER exercises in relation to their own confidential and proprietary information.

(D) USER agrees to return the PRODUCT to DESIGN ANALYSIS if and when the PRODUCT is deemed to be no longer of use. In return therefore, USER will receive from DESIGN ANALYSIS a redemption fee of $10.00.

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The PRODUCT is made available under license from DESIGN ANALYSIS. In consideration of payment, USER is hereby granted a limited right under applicable trade secret and copyright rights to use the PRODUCT. THE PAYMENT DOES NOT CONSTITUTE A PURCHASE OF THE PRODUCT, AND THE RIGHT TO USE THE PRODUCT IS NONTRANSFERABLE, EXCEPT TO A PARTY AGREEING TO BEING BOUND BY TERMS CONSISTENT WITH THIS AGREEMENT. THIS MEANS THAT THE USER IS NOT AUTHORIZED TO SELL OR LEASE THE RIGHT TO USE THE PRODUCT OR ANY PORTION THEREOF TO ANY INDIVIDUAL OR COMPANY GAIN, OR OTHERWISE WITHOUT OBTAINING THE AGREEMENT OF SUCH INDIVIDUAL OR COMPANY TO ABIDE BY THE TERMS OF THIS AGREEMENT. ALL RIGHTS NOT SPECIFICALLY GRANTED ABOVE ARE RESERVED BY DESIGN ANALYSIS.

5. TERM

USER may enjoy these rights only as long as their possession of the PRODUCT shall continue to be rightful. These rights will cease if the PRODUCT is returned to DESIGN ANALYSIS under the terms of any redemption offer, warranty, or money-back guarantee, or if USER transfers the PRODUCT to another party on terms inconsistent with this agreement.

6. LIMITED WARRANTY

(A) WHAT IS COVERED

DESIGN ANALYSIS warrants that for a period of six months from the time of purchase the functions to be performed by the PRODUCT will be substantially in compliance with USER documentation. DESIGN ANALYSIS also warrants that the PRODUCT will be free from defects in materials and workmanship for a period of ONE YEAR from the date of purchase.

(B) WHAT USER MUST DO

If the product fails to satisfy the above warranty, USER must notify DESIGN ANALYSIS in writing within the applicable period specified above and reasonably cooperate with the directions they received from DESIGN ANALYSIS.

(C) WHAT DESIGN ANALYSIS WILL DO

DESIGN ANALYSIS will repair the PRODUCT or will endeavor to provide a replacement of same within a reasonable period of time. In the event that DESIGN ANALYSIS is unable to make the necessary repairs or replacement within a reasonable period of time, the original purchase price will be refunded upon the return of the PRODUCT to DESIGN ANALYSIS.

(D) LIMITATIONS

(I) THIS LIMITED WARRANTY IS VOIDED WHERE THE SEALED HOUSING OF THE PRODUCT HAS BEEN OPENED.

(II) THE ENTIRE REMEDY FOR BREACH OF THIS LIMITED WARRANTY SHALL BE LIMITED TO REPLACEMENT OF THE DEFECTIVE PRODUCT OR REFUNDING OF THE PURCHASE PRICE, AS SET FORTH ABOVE. IN NO EVENT WILL THE LIABILITY OF DESIGN ANALYSIS TO USER OR TO ANY OTHER PARTY EXCEED THE ORIGINAL PURCHASE PRICE OF THE PRODUCT, REGARDLESS OF THE FORM OF THE CLAIM.

(III) EXCEPT FOR THE EXPRESS WARRANTIES ABOVE, DESIGN ANALYSIS SPECIFICALLY DISCLAIMS ALL OTHER WARRANTIES, INCLUDING, WITHOUT LIMITATION, ALL IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

(IV) UNDER NO CIRCUMSTANCES WILL DESIGN ANALYSIS BE LIABLE FOR SPECIAL, INCIDENTAL, CONSEQUENTIAL, INDIRECT, OR ANY OTHER DAMAGES OR CLAIMS ARISING FROM THE USE OF THIS PRODUCT, THIS INCLUDES LOSS OF PROFITS OR ANY OTHER COMMERCIAL DAMAGES, EVEN IF ADVISED OF THE POSSIBILITY OF SUCH DAMAGES. IN NO EVENT WILL DESIGN ANALYSIS BE LIABLE FOR ANY CLAIMS, LIABILITY, OR DAMAGES ARISING FROM MODIFICATION MADE THEREIN, OTHER THAN BY DESIGN ANALYSIS.

(V) Should the exclusive remedy stated in subparagraph 6 (d) (ii) above be determined by a proper court of law to have failed of its essential purpose, the limitation of the obligations of DESIGN ANALYSIS stated in subparagraphs 6 (d) (iii) and (iv) shall remain valid.

(VI) THIS LIMITED WARRANTY GIVES USER SPECIFIC LEGAL RIGHTS. USER MAY ALSO HAVE OTHER RIGHTS WHICH VARY FROM STATE TO STATE. SOME STATES DO NOT ALLOW LIMITATIONS ON HOW LONG AN IMPLIED WARRANTY LASTS OR THE EXCLUSION OF INCIDENTAL OR CONSEQUENTIAL DAMAGES, SO THOSE LIMITATIONS OR EXCLUSIONS MAY NOT APPLY.

7. BINDING AGREEMENT

This is a binding agreement, and if not understood, USER should seek competent legal advice. By paying for the PRODUCT and opening the package, USER acknowledges to have read this Agreement and have agreed to be bound by its terms and conditions.

8. COMPLETE AGREEMENT

This agreement is the complete and exclusive statement of the agreement between USER and DESIGN ANALYSIS and supersedes all proposals for prior agreements and understandings, whether oral or written, and all other communications relating to the subject matter of this agreement.

9. GOVERNING LAW

This Agreement and its validity and interpretation shall be governed by the laws of the State of Utah, notwithstanding any choice of law rules of Utah or any other state or jurisdiction.

10. U.S. GOVERNMENT RESTRICTED RIGHTS

Use, duplication, or disclosure by the United States Government is subject to restrictions set forth in paragraph (c) (1) (ii) of the rights in Technical Data and Computer Software clause at 52.227-7013. The Contractor-manufacturer is DESIGN ANALYSIS ASSOCIATES, INC., 75 West 100 South, Logan, Utah 84321.

Chapter 1
Introduction

1.1 Overview of the "*WATER*LOG"

The "***WATER*LOG**" Sensor/Logger, as shown in Figure 1-1, is an innovative water level measurement system for use in ground and surface water measurement. Its design can eliminate the need for an instrument shelter or other site improvements. You will find the "***WATER*LOG**" very reliable and easy to use. The small cylindrical design fits well casings as small as 2 inches in diameter. It can be deployed below ground surface to minimize temperature effects and vandalism. The "***WATER*LOG**" is self-contained with batteries and a reliable non-volatile FLASH EEPROM memory.

The 1/4" polyethylene tubing (vented cable) encloses the data cable and provides an atmospheric vent for the sensor. Precautions should be taken to avoid kinks or leaks in the vented cable. A kink in the vented cable would interfere with the atmospheric reference and cause errors in your data. A leak would allow moisture to enter and damage the pressure transducer.

The "***WATER*LOG**" contains an internal dry air system which maintains the atmospheric reference to the sensor and protects the sensor and electronics from moisture condensation.

The "***WATER*LOG**" comes with convenient user software which executes on any IBM compatible computer. The software is used to initialize the "***WATER*LOG**" and configure it for long term unattended data logging. It also is used to retrieve the data from the logger. The retrieved data is stored in a convenient format for analysis using the ***WATER*WARE™** software or commercial analysis software.

The "***WATER*LOG**" is powered by a field replaceable "D" cell Lithium battery pack. It is a low-power device and is designed to operate up to five years on the battery pack.

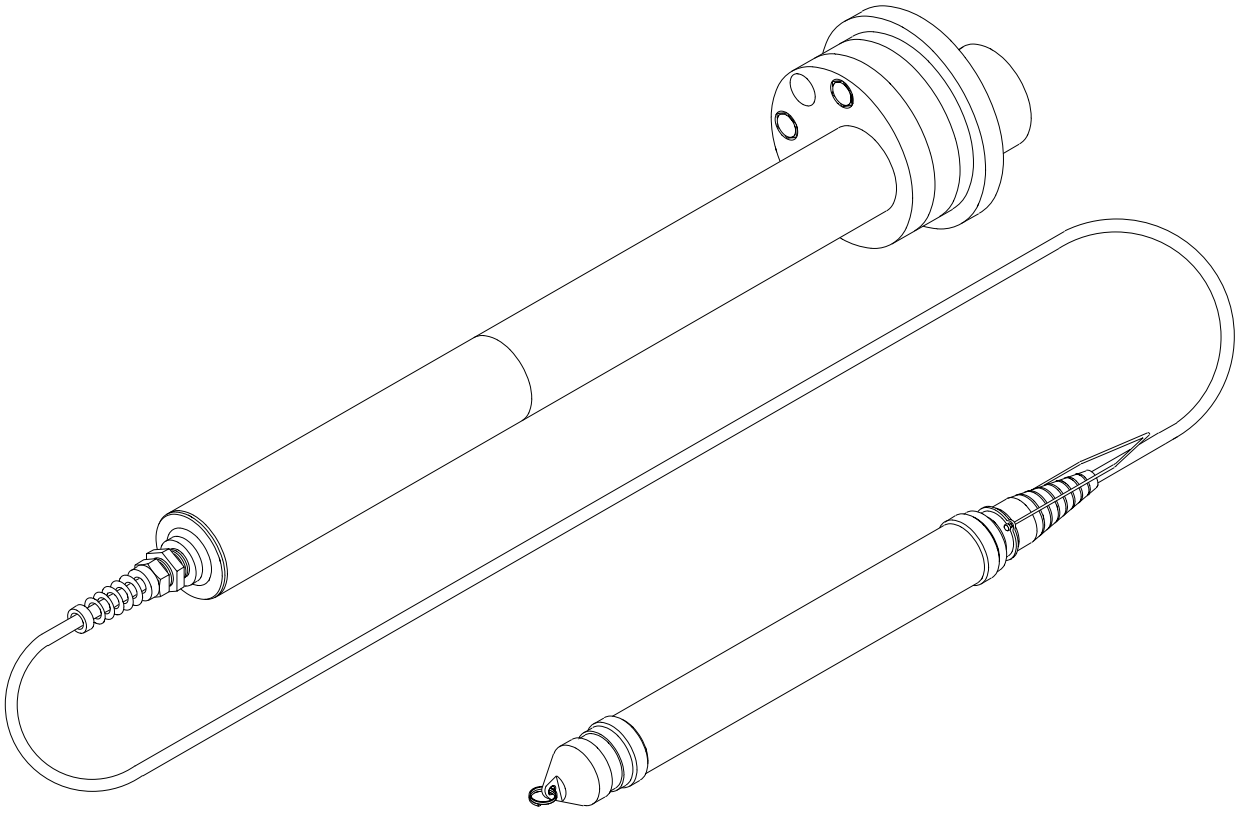

Figure 1-1. The "***WATER*LOG**" Sensor/Logger

1.2 Unpacking the "*WATER*LOG"

Here are the items you should have received:

1. ***WATER*LOG®** Series **"*WATER*LOG"** pressure transducer/data logger with polyethylene vented cable. (Custom length)
2. Stainless Steel Ballast
3. The Owner's Manual
4. RS-232 Cable
5. Three spare desiccant packs
6. ***WATER*WARE™** Software
7. Spare Dry Air Filter
8. (Optional) Stainless Steel suspension cable and miscellaneous hardware

1.3 Checking the Model Number

Before installing your new ***"WATERLOG"***, check the information on the label of the sensor enclosure. Check the model number, the range, and the output type to be sure that you have received the instrument you ordered. The label will look similar to the following:

Model: DH-21
SN: 12345
Range: 0-15 psi

This example shows that the ***"WATERLOG"*** Model DH-21 measures pressure within the range from 0 to 15 psi. A similar label can be found on the battery compartment at the top end of the vented cable.

1.4 Testing the System

Before installing the ***"WATERLOG"***, you may wish to test the system by connecting it to your computer in the shop or lab. Testing the ***"WATERLOG"*** in the shop or lab and observing its readings will familiarize you with the instrument in an environment where it is easy to work and you are near a telephone if questions should arise.

The ***"WATERLOG"*** is shipped from the factory with the batteries disconnected. You will need to connect the batteries before you can communicate with the ***"WATERLOG"*** (see Section 2.3 "Accessing the Battery Pack and Desiccant"). You will also need to install the software on your computer (see Section 3.1 or 4.1 for software installation instructions). After connecting the batteries and the RS-232 cable, and installing the software, run WATERLOG.EXE from your computer. You will be able to communicate directly with the sensor, set up parameters for logging, set the time and date, etc. You should familiarize yourself with each of the features of the software (see Chapters 3 and 4 for detailed explanations of each version of the software).

If you are unable to establish communication with the ***"WATERLOG"***, refer to Section 6.2, Trouble Shooting. If you have exhausted all possibilities in the trouble shooting section, feel free or call one of our support personnel at (435) 753-2212 for further assistance.

Chapter 2
Installation

2.1 Installing the "*WATER*LOG"

This chapter covers installation techniques for the "***WATER*LOG**". For proper installation, you will need the following:

1. The Owner's Manual
2. Your "***WATER*LOG**" instrument
3. A fresh 7.2 Volt battery pack
4. RS-232 Cable
5. (Optional) Well head compression seal or stream installation package
6. (Optional) Stainless steel drop cable
7. (Optional) Cable clamps for fastening the drop cable
8. IBM compatible computer (usually a laptop computer) for programming and setup of the "***WATER*LOG**"

2.1.1 Sensor Deployment

There are many ways to deploy the **"*WATER*LOG"**. However, there are some site preparations and maintenance that must be considered.

If the sensor is to be clamped or tied down at a fixed location, the sensor must be where there is no velocity flow. The **"*WATER*LOG"** contains a pressure sensor and changes in flow correlate to changes in pressure. Thus, if the sensor is subjected to open flow, there is a good chance your readings will be inaccurate. **Key point: Use stilling wells, sand points, or other "no flow" installation techniques.** The result will be very accurate, reliable data.

The **"*WATER*LOG"** can be hung in well bores and float type stilling wells or conduits. If this is the type of installation that is being done, the **"*WATER*LOG"** should be installed by suspending the sensor not by its polyethylene vent cable, but by using a stainless steel drop cable and by using a weighted ballast or sinker, such as the one that has been provided. The ballast will cause the sensor to sink to the desired depth and will help the sensor to hang straight down. Adjust the cable such that the weight of the sensor is entirely on the steel cable, not the vent tube. Allow a small service loop in the vent tube to allow for future expansion and contraction of the plastic tubing. The stainless cable and the miscellaneous hardware can be purchased from Design Analysis Associates.

The polyethylene vent cable has an extremely large thermal coefficient of expansion. This coupled with the fact that the polyethylene tubing will stretch with applied weight, make the use of the stainless steel drop cable a must. **Use of the stainless steel drop cable will insure long term stability. <u>THIS IS A MUST!!!</u>**

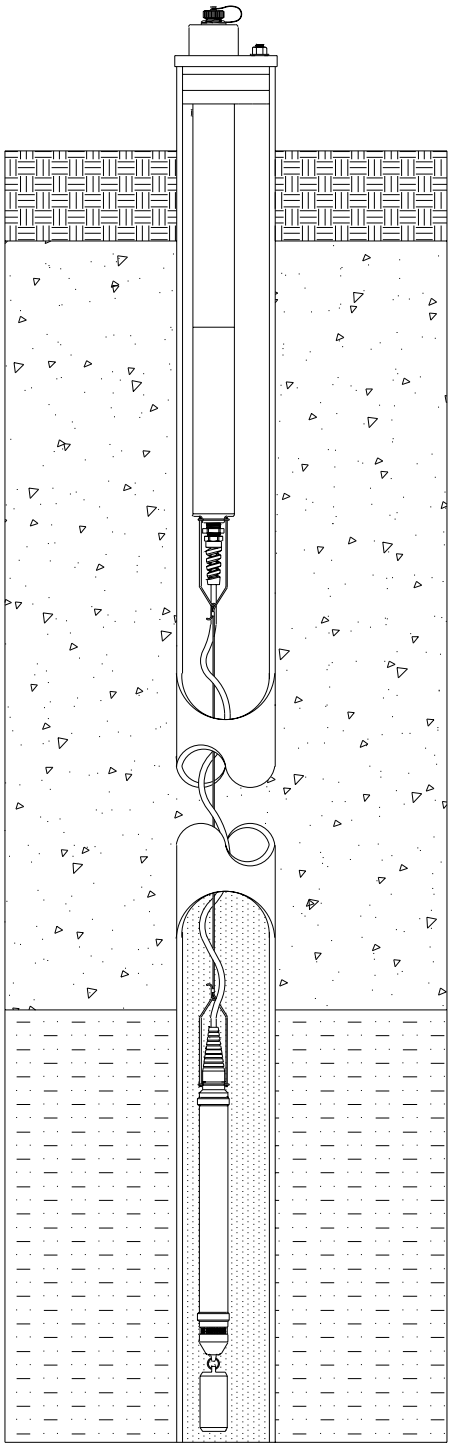

Figure 2-1.
Typical Small Bore Well Installation

2.1.2 Sample Well Installation

The "***WATER*LOG**" can be used inside a well casing. Figure 2-1 illustrates a typical ground well installation. The "***WATER*LOG**" is suspended from the bail hook on the bottom end of the well head assembly using the stainless steel cable. One end of the stainless steel cable is attached to the support bail on the sensor and the other end is fastened to the ring on the bottom of the battery compartment. The ballast is attached to the ballast hook of the sensor, as shown in Figure 2-1. The well head assembly slides through a 1-1/2" compression well cap (optional). It is important that the well head assembly is not submersed. There is a vent hole on the side of the well head assembly near the top which provides the sensor with a reference to atmospheric pressure. The lower endcap of the well head assembly is moisture resistant but not watertight.

When using submersible gage pressure transducers you must provide some means of venting the well. The vent port of the pressure transducer must be open to the atmosphere to allow for proper compensation of changes in barometric pressure. If a sanitary well seal is used, you must drill a hole in the cap or provide other means of venting the well. If you purchased the well cap from Design Analysis Associates, the vent is already provided.

2.1.3 Environmental Concerns

Through years of experience dealing with measuring in the environment, we have learned that Mother Nature is very unforgiving to electronic equipment. There are several environmental concerns with respect to installation and use of the **"*WATER*LOG**".

1. Although the **"*WATER*LOG"** is submersible, it cannot be frozen. **Damage will occur to the sensor if it is frozen.** Transducers which are installed in geographical areas with harsh winters should be removed for the winter unless they are deep enough in the water that there is no danger of freezing. Ice may form around the vent tube without causing damage or performance degradation. However, the vent tube should be placed so as to minimize the possibility of it being ripped as the ice shifts or breaks up during times of thawing.

2. As with all plastics, the polyethylene vent tube is sensitive to ultraviolet (UV) light. If subjected to intense UV light for extended periods of time, rotting of the tube will occur. Whenever possible, precautions should be taken to protect the above-water portion of the vent tube from sunlight.

3. Experience has shown that if part of the sensor enclosure of the **"*WATER*LOG"** is above the water and exposed to sunlight (e.g. installed in shallow water), a temperature gradient can occur inside of the enclosure which will cause a partial pressure on the reference side of the sensor. This pressure will raise or lower the **"*WATER*LOG"** pressure reading depending on the polarity of the partial pressure. This is a "Laws of Physics" problem not unique to ***WATER*LOG**® Series transducers. It can easily be overcome by installing the transducer horizontally so that the entire enclosure is covered by water.

2.2 Connecting the "*WATER*LOG" to a Computer

To connect the "***WATER*LOG**" to your computer, remove the cap on the RS-232 connector and plug the mating end of your RS-232 cable into it. Connect the other end of the RS-232 cable to a serial port on your computer (COM 1 or COM 2) and run the WATERLOG.EXE software.

Note: Do not leave the "***WATER*LOG**" **connected to a computer for long periods of time. By doing so, the** "***WATER*LOG**" **stays in an active state drawing its maximum current continuously. This will greatly shorten battery life.**

Figure 2-2 shows the pin configuration for both ends of the RS-232 cable.

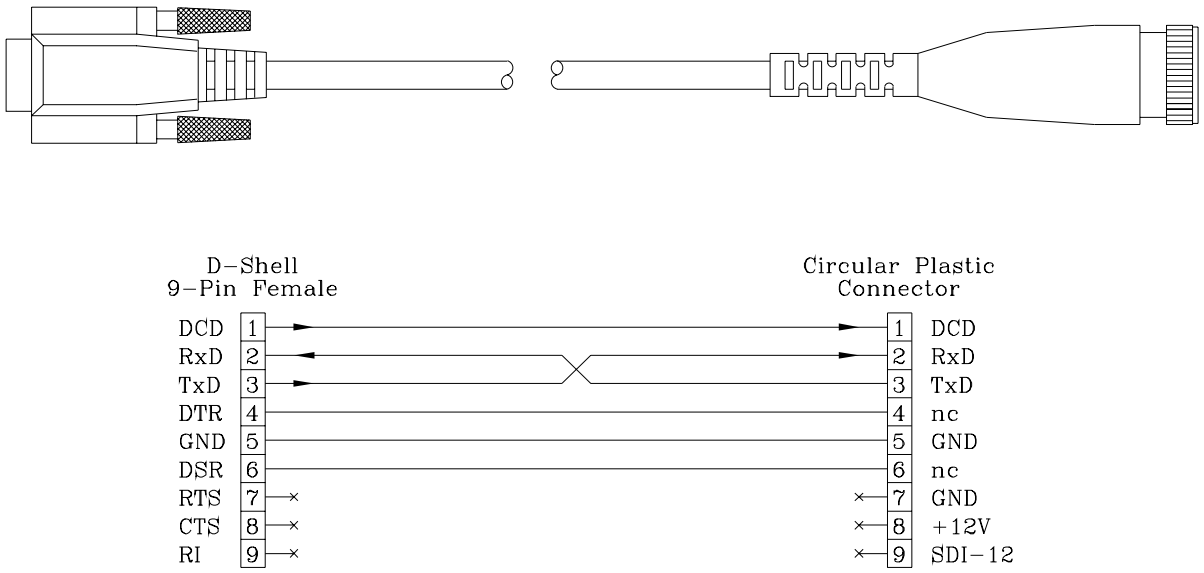

Figure 2-2. RS-232 Cable

2.3 Accessing the Battery Pack and Desiccant

The "***WATER*LOG**" uses a factory assembled 7.2-Volt, 13.5 Amp Hour "D" cell lithium battery pack. The battery can operate the "***WATER*LOG**" for a period of up to 5 years, logging once per day. Logging on 15-minute intervals shortens battery life to 3 years. Likewise, more frequent intervals will shorten battery life even more. A battery voltage measurement is logged on each measurement giving you a record of the rate of discharge and an up-to-date battery voltage.

To access the battery pack, you must remove the well head assembly from the well. Be careful not to kink or damage the vented cable when installing or removing the "***WATER*LOG**". Figure 2-3 shows outlined features of the well head assembly.

The battery compartment is accessed by unscrewing the upper and lower sections of the well head package at the separation joint. Gently pull the Circuit Board/Dry Air Assembly (2) from the lower section. Locate the wires from the battery and connect/disconnect the battery connector.

To remove the Battery Pack (4), disconnect the battery connector, remove the desiccant packs and pull the battery out. A new battery can be installed by following the above instructions in reverse.

The well head assembly also contains a Desiccant Cartridge (1). It is designed to protect the sensor from moisture accumulation. The Desiccant Cartridge (1) and the Desiccant Packs (3) inside the dry air system should be checked every 3 to 6 months. The Desiccant Packs have a transparent strip which allows the condition of the desiccant to be visually checked. Dry desiccant is dark blue and saturated desiccant will have turned pink. The Desiccant Packs and Desiccant Cartridge can be reused by drying them in an oven at 160°F to 180°F for 24 hours or until the desiccant returns to a dark blue color.

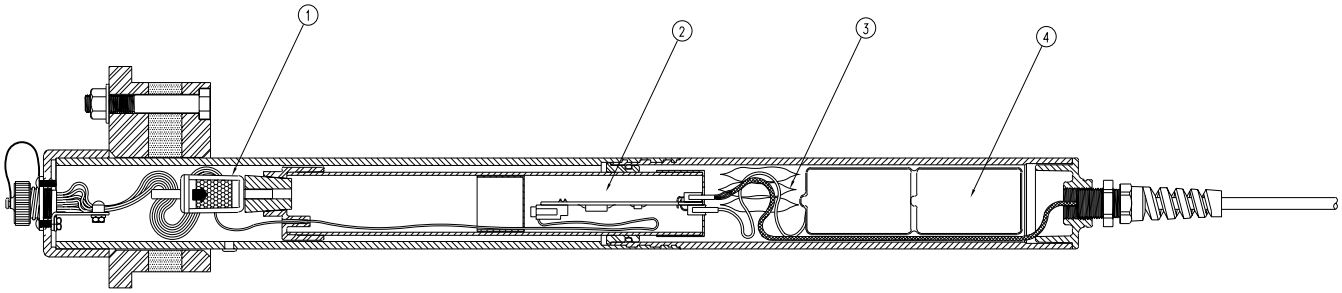

Figure 5-3
Accessing the Battery Pack and Desiccant

Features of the Well Head Assembly:
(1) Desiccant Cartridge
(2) Circuit Board/Dry Air Assembly
(3) Desiccant Packs
(4) Battery Pack

To inspect the Desiccant Cartridge (1), gently pull the Circuit Board/Dry Air Assembly (2) in the direction shown on the label, away from the lower portion of the well head assembly. Remove the Desiccant Cartridge from the rubber plug (do not remove the rubber plug).

When reassembling, firmly press the rubber plug into place before inserting the Desiccant Cartridge. Then gently push the Circuit Board/Dry Air Assembly back into the lower portion of the Well Head Assembly.

2.4 Range of Stage

Use the following chart to determine the maximum depth at which your ***"WATERLOG"*** will measure pressure accurately. Do not place your ***"WATERLOG"*** at more than twice the rated depth for your model's range, or the instrument will be damaged.

Model	Pressure Range	Depth Range	Accuracy 0.05%	0.03%
DH21-05	zero to 05 psi	zero to 11.53 ft.	±0.006 ft.	±0.003*
DH21-15	zero to 15 psi	zero to 34.60 ft.	±0.017 ft	±0.010
DH21-30	zero to 30 psi	zero to 69.20 ft.	±0.035 ft.	±0.021

NOTE: Depth calculations are derived from the standard equation that one psi is generated by a column of water 27.680 inches deep at 39.4°F.

Chapter 3
Using the "*WATER*LOG" Software

3.1 Software Overview and Installation

This chapter explains the menu options available for setting up and running the "***WATER*LOG**" software from either the floppy or hard disk on a PC, Palmtop or laptop computer. The minimum system requirements for running this ***WATER*GEN™** software program is a 8088 processor with 640 K bytes of RAM. **Note: This is <u>not</u> the *WATER*WARE™ Graphical program.**

The "***WATER*LOG**" software program WATERGEN.EXE contains the menus that control and setup the "***WATER*LOG**". This guide shows a step-by-step run-through of the options. The purpose of this guide is to give you a complete understanding of each menu option and how it works. The order of our explanation may not necessarily show the exact sequence of operations you would choose when setting up your unit. Menu options can later be invoked in the order needed to satisfy your setup requirements.

For best performance we recommend loading the software to a hard drive. This can be done by typing the following: (this assumes that the hard disk is the C drive and the floppy drive is A, change these as needed).

```
C:\>cd \
C:\>md WATERLOG
C:\>cd WATERLOG
C:\>copy a:*.* c:
```

The program WATERGEN.EXE can be configured to use either COM1 or COM2.
Note: WATERGEN.EXE uses the standard IBM PC serial port interrupt configuration; IRQ4 for COM1 and IRQ3 for COM2. COM1 is default. COM2 can be used by entering the following: WATERGEN.EXE <PORT> where PORT is defined as follows: <1> = COM1, <2> = COM2. For example: entering "WATERGEN 2" on the command line will select COM PORT 2 for communication with the sensor, provided the sensor is connected to COM PORT 2. To run the program, just type "WATERGEN" at the DOS prompt. If it does not run, make sure you are in the right directory. Type:

```
C:\> cd \
C:\> cd WATERLOG
C:\WATERLOG> WATERGEN (for COM 1) or WATERGEN 2 (for COM 2)
```

Note: The communications cable to the "***WATER*LOG**" Logger must be connected for the software to operate correctly. The cable installation is discussed in Chapter 2.

The screen of the computer is updated every 5 seconds with the logger time, date and data. When the ***WATER*GEN** program is running, it issues a command to the "***WATER*LOG**" telling it to provide the information displayed on the next screen update. When connected to the "***WATER*LOG**" and running the ***WATER*GEN™** program, the "***WATER*LOG**" will change to a continuous operating-power mode from the low-power mode to be able to respond to commands from the computer. This continuous operation shortens battery life and should not be used for long periods in the field unless you are willing to replace the battery more frequently. However, an external 12 volt power source can be connected via the RS-232 communications connector to elevate power drain on internal lithium battery.

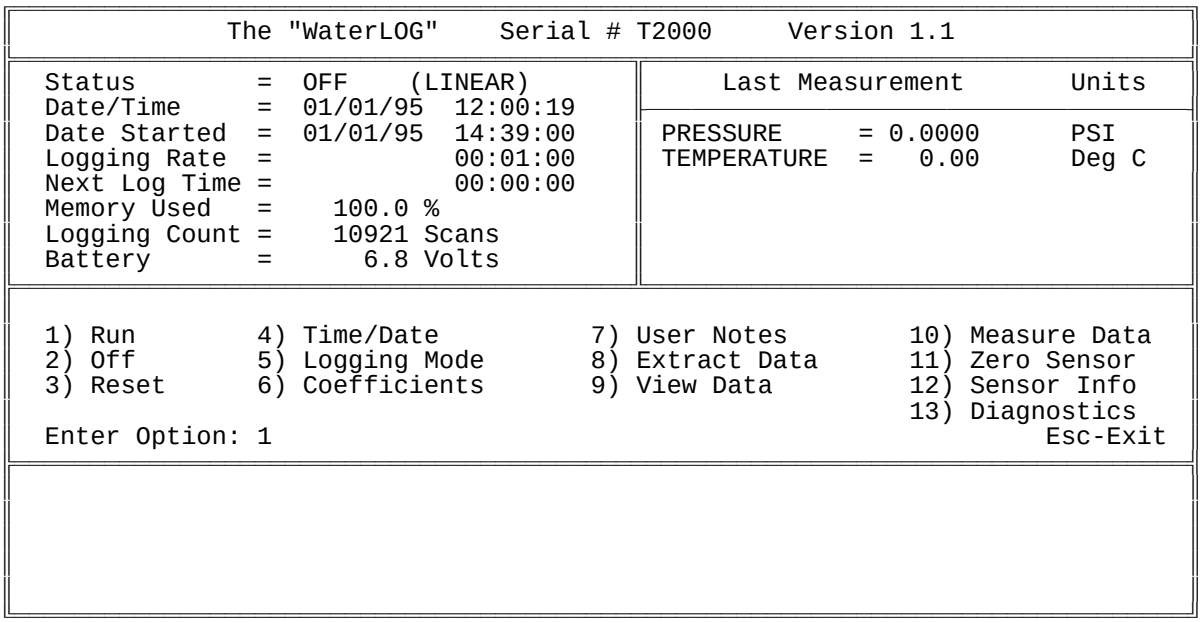

Figure 3-1. Master Menu Screen

Figure 3-1 shows the master menu screen. This screen is divided into five sections. The function of each section is described as follows:

The top window shows the serial number of the "***WATER*LOG**" device along with the version number of the PC software.

The upper left section shows the STATUS or MODE of operation for the "***WATER*LOG**". There are three basic modes of operation: RESET, RUN, and OFF. The next line shows the current date and time as maintained by the clock circuitry in the "***WATER*LOG**". Also shown is the date and time the "***WATER*LOG**" started the current logging session. The Logging Rate indicates the time interval between data samples. The maximum interval allowed is 24 hours. The Next Log Time indicates the time of day when the next sample will be taken if the "***WATER*LOG**" is operating in the RUN mode.

The Memory Used field indicates what percentage of the FLASH EEPROM currently has been filled. The FLASH EEPROM has 128 K bytes of storage. The FLASH EEPROM will not lose data in the event of a power failure and does not depend on a battery to maintain its data. This makes it ideal for remote, unattended data logging.

The Logging Count indicates the number of samples stored by the "***WATER*LOG**". The maximum count is 10,922 counts with a 128 K byte FLASH EEPROM installed. If a sample is taken every hour, the "***WATER*LOG**" will store 10,922 hours worth of data. Dividing 10,922 hours by 24 provides 455 days of sampling. Care should be taken when specifying the sample rate to determine how many samples can be taken, and also to determine how long the batteries will last.

The battery voltage is shown on the computer screen to help you know when the batteries should be replaced. A reading of 7 Volts indicates a good battery, and a reading of 5.5 Volts or lower indicates the battery should be changed. If an external battery is used, it could be as high as 16 volts, but must not exceed this level.

The section in the middle of the screen is a help menu containing the command options which are used to initialize and use the "***WATER*LOG**" sensor/logger. You can invoke each option by typing the number of the option and pressing the ENTER Key on the computer.

The blank section at the bottom of the screen is used for software interaction with the user. Various information and options are displayed in this section.

The upper right window displays the results of the last measurement of the sensor. The scaling and user units are explained in this chapter.

A "***WATER*LOG**" sensor MUST be connected in order for the status information and options to work.

3.2 Configuration Options Menu

3.2.1 Reset Option

For now we will skip the **Run** and **Off** options. Figure 3-2 shows a sample screen when the "***WATER*LOG**" sensor is first installed. Notice the time and date values are meaningless and need to be initialized. The first option that should be invoked is the Reset (option 3). Press the number "3" key followed by <ENTER>. You will be notified that all data will be erased and the sensor will be reset. Enter a "y" <ENTER> on the keyboard to accept the Reset function.

```
                The WaterLOG    Serial # T2000     Version 1.1

  Status         =  OFF    (LINEAR)          Last Measurement       Units
  Date/Time      =  01/01/95  12:00:47
  Date Started   =  01/01/95  14:39:00    PRESSURE     = 0.0000      PSI
  Logging Rate   =            00:01:00    TEMPERATURE  =   0.00      Deg C
  Next Log Time  =            00:00:00
  Memory Used    =    100.0 %
  Logging Count  =    10921 Scans
  Battery        =      6.8 Volts


  1) Run         4) Time/Date          7) User Notes        10) Measure Data
  2) Off         5) Logging Mode       8) Extract Data      11) Zero Sensor
  3) Reset       6) Coefficients       9) View Data         12) Sensor Info
                                                            13) Diagnostics
  Enter Option: 3                                                  Esc-Exit

 Reset
  This will erase all data and reset the sensor.
  Continue?  y   (y/n)

                                                                   Esc-Exit
```

Figure 3-2. Reset Option

Warning : This option should not be invoked if the user has uncollected data in the FLASH EEPROM which needs to be extracted. In the event of a dead battery, the memory pointers in the "***WATER*LOG**" will point to the last location in memory. Therefore, you can use the extract data menu option number "8" to extract the data before resetting the "***WATER*LOG**".

3.2.2 Time/Date Option

You can invoke menu item 4 as shown in Figure 3-3. The correct date and time must be typed in the format shown on the screen. This date and time are stored in the "***WATER*LOG**". The clock circuitry in the "***WATER*LOG**" is powered from the main battery of the "***WATER*LOG**". **You should always invoke the Reset and Time/Date options whenever the battery is changed**. All data should be extracted from the "***WATER*LOG**" before changing the battery or resetting.

```
                The WaterLOG    Serial # T2000     Version 1.1

  Status         =  RESET  (LINEAR)          Last Measurement       Units
  Date/Time      =  01/01/95  12:01:18
  Date Started   =  01/01/95  14:39:00    PRESSURE     = 0.0000      PSI
  Logging Rate   =            00:01:00    TEMPERATURE  =   0.00      Deg C
  Next Log Time  =            00:00:00
  Memory Used    =      0.0 %
  Logging Count  =        0 Scans
  Battery        =      6.8 Volts


  1) Run         4) Time/Date          7) User Notes        10) Measure Data
  2) Off         5) Logging Mode       8) Extract Data      11) Zero Sensor
  3) Reset       6) Coefficients       9) View Data         12) Sensor Info
                                                            13) Diagnostics
  Enter Option: 4                                                  Esc-Exit

 Time/Date

  Enter Date: 02/28/95   (01/01/00 to 12/31/99)
  Enter Time: 03:50:00   (00:00:00 to 23:59:59)
                                                                   Esc-Exit
```

Figure 3-3. Time/Date Option

3.2.3 Logging Mode Option

Options 5, 6, and 7 configure the "***WATER*LOG**" for unattended logging. Option 5 is shown in Figure 3-4. The logging rate indicates the elapsed time between measurements. The "***WATER*LOG**" clock circuitry allows the "***WATER*LOG**" to enter a low-power "SLEEP" mode of operation between measurements. Then when the selected measurement time interval has elapsed, which is specified in option 5, the "***WATER*LOG**" will "WAKE-UP" and take a pressure, temperature and battery measurement. It will then store the data in FLASH EEPROM with a time-stamp, and go to "SLEEP" again.

The time between samples can range from 1 second up to 24 hours. If the logging rate is less than 6 seconds, the "***WATER*LOG**" will not go to "SLEEP".

The "***WATER*LOG**" "WAKES-UP" and takes a measurement when the time in the DATE/TIME field matches the "Next Log Time". The "Next Log Time" is incremented by the logging rate. If the new "Next Log Time" has already occurred, the "***WATER*LOG**" will continue to add the logging rate to the new Next Log Time until the new Next Log Time is in the future. Then the "***WATER*LOG**" will "WAKE-UP" to take the next sample.

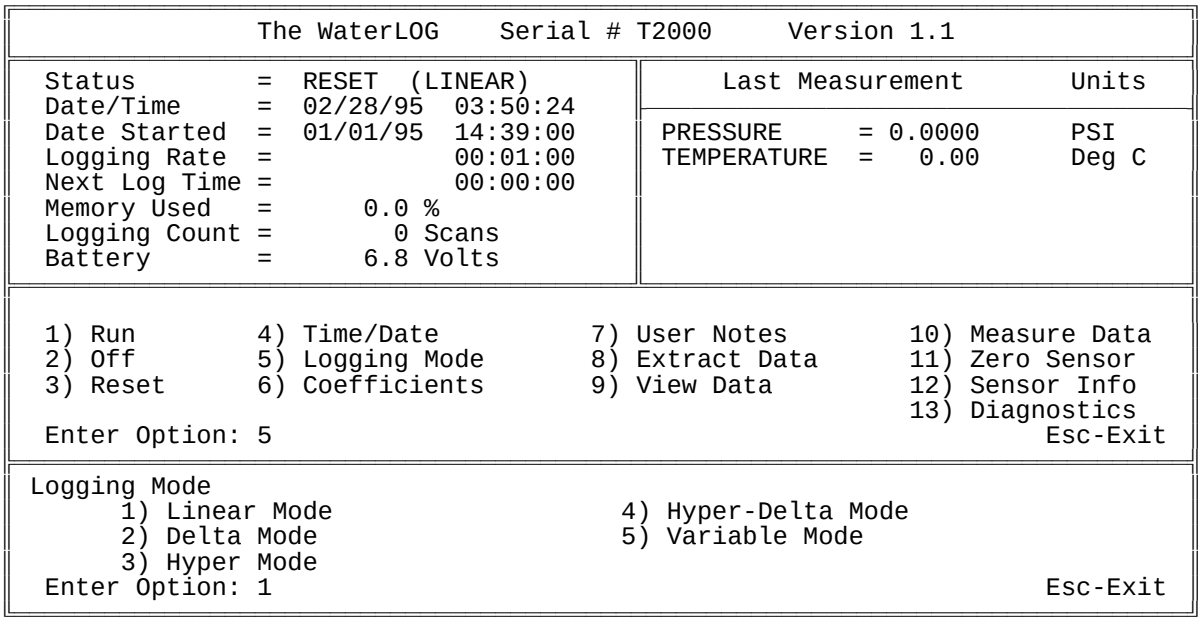

Figure 3-4. Logging Rate Option

There are five different sampling modes the "***WATER*LOG**" sensor can operate under. Each Logging Mode is briefly explained below:

Linear Mode:

The Linear Mode is the simplest and allows the sensor to log data at a set time interval from once a second to once a day. Linear Mode is shown in Figure 3-5.

Delta Mode:

The Delta Mode, like the Linear Mode, allows for the selection of a fixed sample interval between 1 second to 24 hours. However, there is an addition of being able to set the minimum amount of level change required before data will be logged. This feature saves memory. Delta Mode is shown in Figure 3-6.

Hyper Mode:

The Hyper Mode, also like the Linear Mode, allows for the selection of a fixed sample interval between 1 second to 24 hours. The Hyper Mode, however, allows for the entry of a level change between the pass and current measurement (rate of change) that will cause the "***WATER*LOG**" to increase the logging rate based on a predetermined value. The Hyper Mode is shown in Figure 3-7.

Hyper-Delta Mode:

The Hyper-Delta Mode is a combination of the Hyper Mode and the Delta Mode. The Hyper-Delta Mode is shown in Figure 3-8.

Variable Mode:

The Variable Mode provides 6 time periods to be set up with different logging rates. The length of the time periods can also be adjusted. This Logging Rate can be used to simulate a logarithmic logging function. Variable Mode is shown in Figure 3-9.

3.2.3.1 Linear Logging Mode Option

The Linear Logging Mode shown in Figure 3-5 is configured to have a constant time between each measurement. This allows you to change the value of the logging rate by using the up and down arrow cursor keys on the keyboard. When the correct logging rate is displayed, push the <ENTER> key and the "***WATER*LOG**" will be programmed for the desired interval.

```
                The WaterLOG    Serial # T2000     Version 1.1

  Status        =  RESET  (LINEAR)        Last Measurement       Units
  Date/Time     =  02/28/95  03:50:24
  Date Started  =  01/01/95  14:39:00   PRESSURE     = 0.0000      PSI
  Logging Rate  =            00:01:00   TEMPERATURE  =   0.00      Deg C
  Next Log Time =            00:00:00
  Memory Used   =      0.0 %
  Logging Count =        0 Scans
  Battery       =      6.8 Volts


  1) Run        4) Time/Date          7) User Notes        10) Measure Data
  2) Off        5) Logging Mode       8) Extract Data      11) Zero Sensor
  3) Reset      6) Coefficients       9) View Data         12) Sensor Info
                                                           13) Diagnostics
  Enter Option: 5                                                 Esc-Exit

 Linear Mode

  Adjust Logging Rate: 00:01:00

 Home, End, ↑, ↓                                                 Esc-Exit
```

Figure 3-5. Linear Mode Option

3.2.3.2 Delta Logging Mode Option

The Delta Logging Mode shown in Figure 3-6 provides the means to log data only if it is changing more than a set limit.

Logging Rate:

Set between 1 second to 24 hours. This is just like in the Linear Mode.

Delta Limit:

The Delta Limit sets the point that determines if the scanned data is to be logged or not. Each time the sensor takes a reading, the "***WATER*LOG**'s" internal software computes the absolute difference between the last logged reading and present reading. If the difference between the new value and the last logged value is less than the Delta Limit, the sensor will not log the new data. If the difference between the present reading and the last logged data is greater than the delta limit, the new data will be logged.

This option is handy for saving memory space since data is not logged if the data does not change more than the Delta Limit. You must decide how much change in level can happen before the sensor logs the data. Note that this check is on the level parameter only, not the temperature, and the value entered will be in the same units as set in the coefficients options. For example, if the coefficients units are set to feet, the Delta Limit will be in feet also.

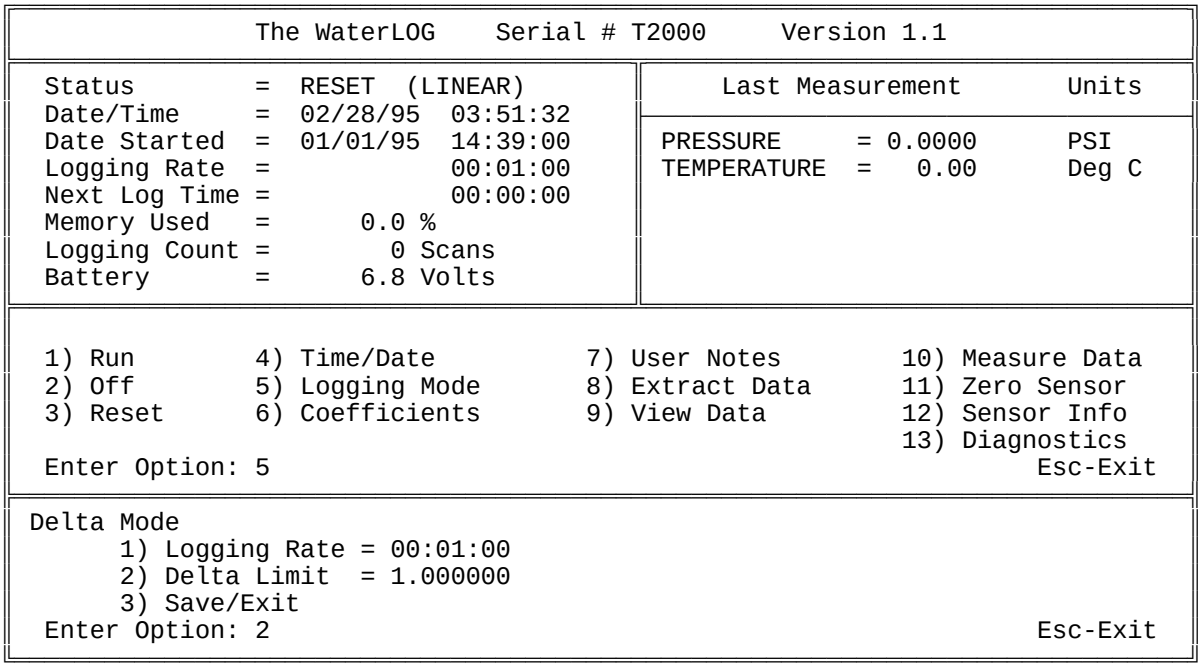

Figure 3-6. Delta Mode Option

3.2.3.3 Hyper Logging Mode Option

The Hyper Logging Mode shown in Figure 3-7 is used to log data at a regular time interval, like the linear mode, but if the rate of change of the level reading is greater than a set rate, the logging rate can be increased to a faster logging rate. In this mode all scanned data will be saved.

Logging Rate: Set between 1 second to 24 hours. This is just like in the Linear Mode.

Hyper Limit: The Hyper Limit will be expressed in the unit of measure specified under the conversion options with inches, feet, meters, PSI, etc., being common units for this field. As long as the difference between the current scanned level and the last logged level is less than this set hyper limit, the scan rate will stay at the regular rate. If the difference is greater than the set hyper limit, the scan rate will jump to a faster preset scan rate.

Hyper Divisor: The Hyper Divisor is used to determine the faster scan rate. The faster scan rate is calculated by taking the regular scan rate and dividing it by the hyper divisor.

The hyper divisor must be able to be divided into the regular scan rate without a remainder or it will default to 1. For example, if the regular scan rate is 1 minute, the following hyper divisors are valid:

SCAN RATE	HYPER DIVISOR	FAST SCAN RATE
1 minute	60	1 seconds
1 minute	30	2 seconds
1 minute	20	3 seconds
1 minute	15	4 seconds
1 minute	12	5 seconds
1 minute	10	6 seconds
1 minute	6	10 seconds
1 minute	5	12 seconds
1 minute	4	15 seconds
1 minute	3	20 seconds
1 minute	2	30 seconds
1 minute	1	60 seconds

Here is an example of the Hyper Logging Mode.

The scan rate is set to 15 minutes, the hyper divisor is set to 15, and the hyper limit is set to 0.1 with the units assumed to be in feet. The logger is started and the first data point is logged. The next and all future logs will compute the difference of the current log with the last log. If the difference is less than 0.1, the next log is scheduled to happen in 15 minutes. If the difference is greater than 0.1, the next log is scheduled to happen in 1 minute. (15 minutes/hyper divisor = 1). The sensor will stay on the 1 minute interval until the next 15 minute interval, at which time the sensor will evaluate the current log with the log 15 minutes previous to see if it should remain in the hyper mode or jump back to the normal scan rate.

This option allows the sensor to capture and record quick changing data without the expense of battery life by adjusting the scan rate based on the data change rate.

It is important for you to realize that the faster scan rate will not start until the sensor determines a change has taken place between the last scan and the present scan. For instance, in our example the time between last and present scans was 15 minutes. Therefore, some of the event you are trying to track may be missed. Thus you need to determine what scan intervals are best suited for the dynamics of the intended application.

Again, note that this check is on the level parameter only, not the temperature, and the value entered will be in the same units as set in the coefficients options. For example, if the coefficients units are set to read out in feet, the hyper limit will also be in feet.

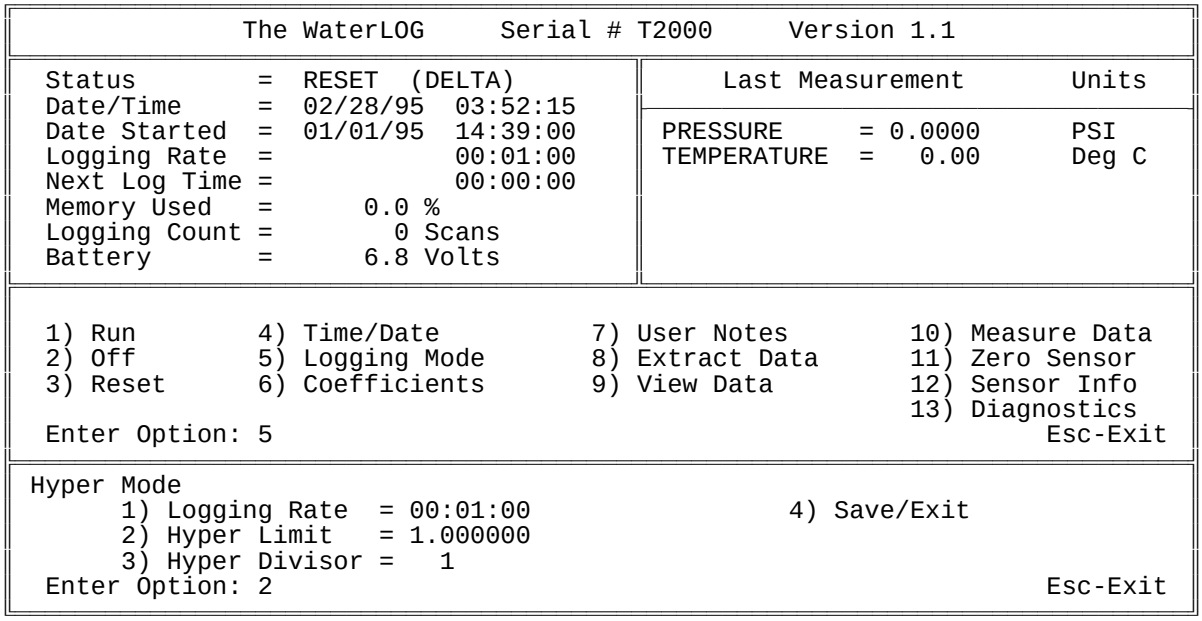

Figure 3-7. Hyper Mode Option

3.2.3.4 Hyper-Delta Logging Mode Option

The Hyper-Delta Mode shown in Figure 3-8 is a combination of both the Hyper Mode and the Delta Mode. The Hyper-Delta mode is probably the most versatile mode of measurement on the market to date.

Logging Rate: Set between 1 second to 24 hours. This is just like in the Linear Mode.

Delta Limit: The Delta Limit sets the point that determines if the scanned data is to be logged or not. Each time the sensor takes a reading, the "***WATER*LOG**'s" internal software computes the absolute difference between the last logged reading and present reading. If the difference between the new value and the last logged value is less than the Delta Limit, the sensor will not log the new data. If the difference between the present reading and the last logged data is greater than the Delta Limit, the new data will be logged.

Hyper Limit: The Hyper Limit will be expressed in the units of measure specified under the conversion options with inches, feet, meters, psi, etc., being common units for this field. As long as the difference between the current scanned level and the last logged level is less than this set hyper limit, the scan rate will stay at the regular rate. If the difference is greater than the set hyper limit, the scan rate will jump to a faster preset scan rate.

Hyper Divisor: The Hyper Divisor is used to determine the faster scan rate. The faster scan rate is calculated by taking the regular scan rate and dividing it by the hyper divisor. The hyper divisor must be able to be divided into the regular scan rate without a remainder or it will default to 1. For example, if the regular scan rate is 1 minute, the following hyper divisors are valid:

SCAN RATE	HYPER DIVISOR	FAST SCAN RATE
1 minute	60	1 seconds
1 minute	30	2 seconds
1 minute	20	3 seconds
1 minute	15	4 seconds
1 minute	12	5 seconds
1 minute	10	6 seconds
1 minute	6	10 seconds
1 minute	5	12 seconds
1 minute	4	15 seconds
1 minute	3	20 seconds
1 minute	2	30 seconds
1 minute	1	60 seconds

This option allows the sensor to capture and record quick changing data without the expense of battery life by adjusting the scan rate based on the data change rate. It also saves memory by not logging data when the data is not changing significantly.

Note that this check is on the level parameter only, not the temperature, and the values entered for the Hyper Limit and Delta Limit will be in the same units as set in the coefficients options. For example, if the coefficients Pressure / Level option is set to feet, the Hyper Limit and Delta Limit will also be in feet.

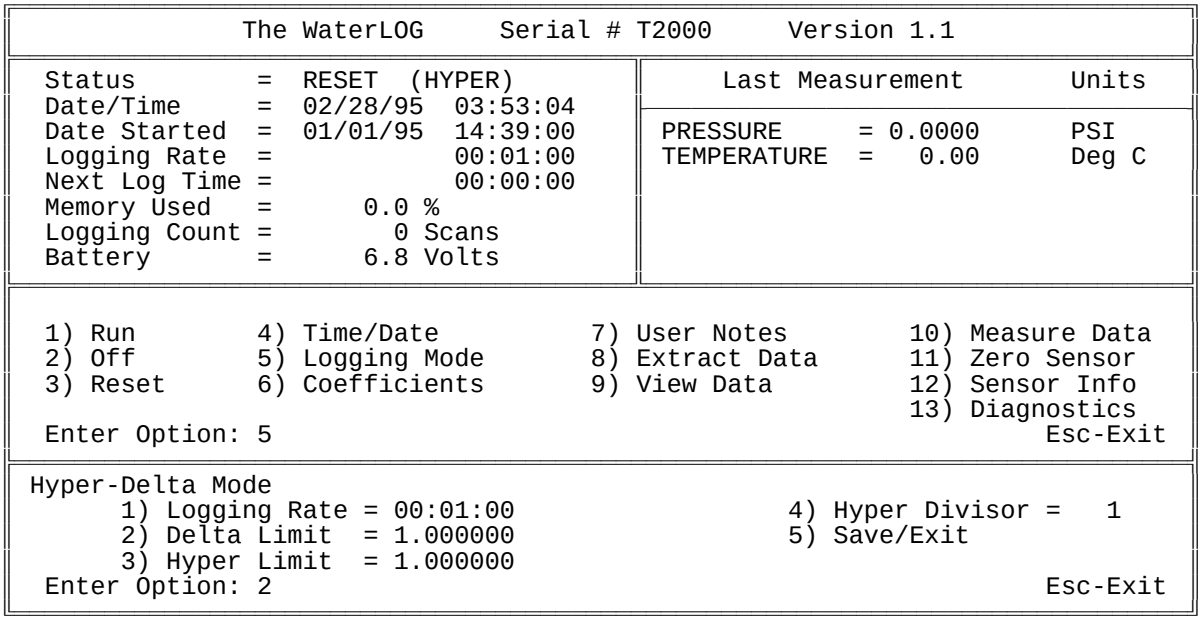

Figure 3-8. Hyper-Delta Mode Option

3.2.3.5 Variable Logging Mode Option

The Variable Logging Mode shown in Figure 3-9 is used to set up special logging modes. It can be used to build logarithmic logging sample rates for pump or slug testing of wells. There are six different sampling time periods in this mode and each can be set for a different logging rate and duration.

Enter Option: This allows you to select one of the six independent sampling bands consisting of a logging rate and number of samples.

Adjust Logging Rate: This allows you to change the value of the logging rate by using the up and down arrow cursor keys on the keyboard. When the correct logging rate is displayed, push the ENTER Key and the "***WATER*LOG**" will be programmed for the desired interval.

Enter Number of Samples: You can enter the number of samples used for a given logging rate. The number can range from 0 to 9999 samples. There are six time periods, but only options to set the number of samples for the first five. This is because the last time period will log data at the specified logging rate until you stop the logging process. **Setting the number of scans to zero for a time period will cause that time period to be skipped.**

As mentioned, this mode is used to simulate a logarithmic logging mode. Below is a simple setup showing a logarithmic type logging setup.

	Time Between Samples (Rate)	Number of Samples (Samples)	Time Interval
Logging Rate 1	00:00:02	59	0 - 2 min.
Logging Rate 2	00:00:15	32	2 min. - 10 min.
Logging Rate 3	00:02:00	25	10 min. - 1 hr.
Logging Rate 4	00:15:00	28	1 hr. - 8 hrs.
Logging Rate 5	02:00:00	32	8 hrs. - 72 hrs.
Logging Rate 6	12:00:00	On going	72 hrs. -

This example shows the logging rate starting out fast and then slowing down. The rate can change as needed; slow to fast, fast to slow and back to fast, etc.

```
              The WaterLOG     Serial # T2000     Version 1.1

  Status         =  RESET  (HYPER-DELTA)     Last Measurement       Units
  Date/Time      =  02/28/95  03:53:37
  Date Started   =  01/01/95  14:39:00    PRESSURE     = 0.0000      PSI
  Logging Rate   =            00:01:00    TEMPERATURE  =   0.00      Deg C
  Next Log Time  =            00:00:00
  Memory Used    =       0.0 %
  Logging Count  =         0 Scans
  Battery        =       6.8 Volts


  1) Run         4) Time/Date          7) User Notes        10) Measure Data
  2) Off         5) Logging Mode       8) Extract Data      11) Zero Sensor
  3) Reset       6) Coefficients       9) View Data         12) Sensor Info
                                                            13) Diagnostics
  Enter Option: 5                                                  Esc-Exit

 Variable Mode            Rate   Samples     Rate     Samples
                     1) 00:00:05     5    4) 00:01:00     0     7) Save/Exit
                     2) 00:00:30     5    5) 00:01:00     0
                     3) 00:01:00     0    6) 00:01:00  (Final Rate)
  Enter Option: 7                                                  Esc-Exit
```

Figure 3-9. Variable Logging Mode Option

3.2.4 Coefficients Option

The "***WATER*LOG**" Sensor measures temperature and pressure/level. The units for these measurements can be scaled to other engineering units using option number 6 as shown in Figure 3-10. This option needs to be invoked for both temperature and pressure/level. You must first select temperature or pressure/level. The entry is a 1 for temperature and a 2 for pressure/level. Press the <ENTER> key after selecting the proper entry. This will cause an additional 4 options to be displayed. These options allow scaling the sensor pressure/level output from the default of psi to whatever units you choose. The same also applies for the scaling of the sensor temperature output. The "b0" value is an offset or adder term, and "b1" is a multiplier or scaler. The "x" represents the value returned from Sensor. By multiplying "x" (the sensor output) by "b1" and adding "b0", the sensor defaults for pressure/level and temperature. Option 3 lets you label the output units. For example, "Feet" or "Meters" could be used to label the pressure/level output. Figure 3-10 shows a Celsius to Fahrenheit temperature conversion with the Units set to "deg F".

```
              The WaterLOG     Serial # T2000     Version 1.1

  Status         =  RESET  (VARIABLE)        Last Measurement       Units
  Date/Time      =  02/28/95  03:55:21
  Date Started   =  01/01/95  14:39:00    PRESSURE     = 0.0000      PSI
  Logging Rate   =             00:00:05   TEMPERATURE  =   0.00      Deg C
  Next Log Time  =             00:00:00
  Memory Used    =       0.0 %
  Logging Count  =         0 Scans
  Battery        =       6.8 Volts


  1) Run         4) Time/Date          7) User Notes         10) Measure Data
  2) Off         5) Logging Mode       8) Extract Data       11) Zero Sensor
  3) Reset       6) Coefficients       9) View Data          12) Sensor Info
                                                             13) Diagnostics
  Enter Option: 6                                                    Esc-Exit

 User Coefficients and User Units
   Temperature:           y = b0 + b1*x
    1) b0 =  32.000000                3) Units =  Deg F
    2) b1 =  1.800000                 4) Save Coefficients
 Enter Option:  3                                                   Esc-Exit
```

Figure 3-10. Coefficients Option

Note: It is important to program these values correctly. The data displayed in the last measurement window will reflect the scaled value. The "***WATER*LOG**" performs scaling math to the measurement before it is stored into FLASH EEPROM. Also, the extracted data from the "***WATER*LOG**" sensor will reflect the scaled value.

3.2.5 User Notes Option

The "***WATER*LOG**" stores 160 characters of User Notes in the FLASH EEPROM. These notes allow you to enter information which will be recovered during data extraction. Figure 3-11 shows a sample User Notes screen. The cursor is placed in the "User Notes Edit/View" portion of the screen when option 7 is invoked. You can then overwrite or edit the existing notes. To store the entered User Notes, simply press the <ENTER> key. This means the <ENTER> key should not be pressed to go from line to line. The space bar can be used to complete a line where the cursor will wrap around to the next line. You can also use the UP↑, Down↓ and LEFT ←, RIGHT ← arrow keys to move the cursor around the User Notes. When the <ENTER> key is pressed, the software in the computer will down-load the "***WATER*LOG**" with the notes. This process takes several seconds to complete. It might appear nothing is happening because of the time required to transfer the data. The software will return to the main menu when the data has been transferred.

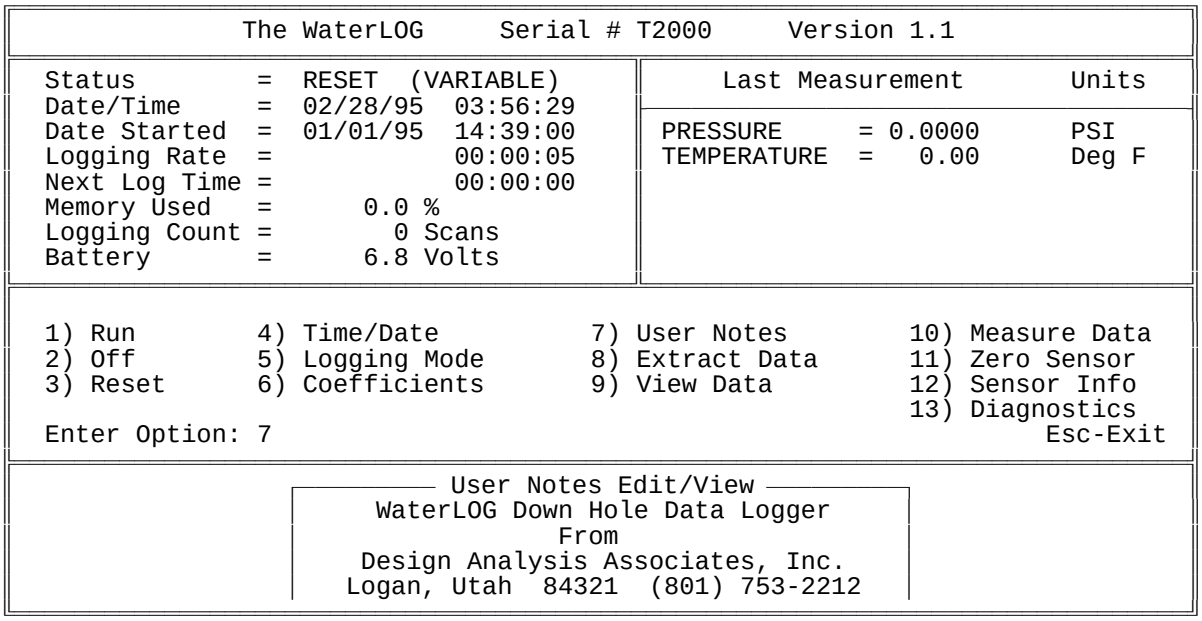

Figure 3-11. User Notes Option

The User Notes can be used to store information while the sensor is logging. This is useful for entering site conditions, for example: "Jan 1, 96 Replaced Battery".

3.2.6 Run Option

There are three basic modes of operation of the "***WATER*LOG**". Up to now the "***WATER*LOG**" has been operating in the RESET mode. The other two modes of operation are RUN and OFF. In the RUN mode of operation, the "***WATER*LOG**" will make a measurement at an interval set by the Logging Option specified in option 5. The data from the samples will be stored in the FLASH EEPROM in the "***WATER*LOG**". The "***WATER*LOG**" will enter a low-power mode of operation to conserve battery power during the wait times. You can cause the "***WATER*LOG**" to enter the RUN mode by selecting option 1 as shown in Figure 3-12. You will be asked to verify the selection to prevent inadvertent operation. With the "***WATER*LOG**" in the RUN mode, you can disconnect the interface cable to the sensor and it will continue to operate in the run mode until manually disabled or battery power is lost. The batteries are designed to operate the unit for up to five years depending on the sample rate.

```
              The WaterLOG     Serial # T2000     Version 1.1

 Status         =  RESET  (VARIABLE)        Last Measurement        Units
 Date/Time      =  02/28/95  03:57:35
 Date Started   =  01/01/95  14:39:00   PRESSURE     = 0.0000      PSI
 Logging Rate   =             00:00:05  TEMPERATURE  =   0.00      Deg F
 Next Log Time  =             00:00:00
 Memory Used    =       0.0 %
 Logging Count  =         0 Scans
 Battery        =       6.8 Volts

  1) Run         4) Time/Date          7) User Notes        10) Measure Data
  2) Off         5) Logging Mode       8) Extract Data      11) Zero Sensor
  3) Reset       6) Coefficients       9) View Data         12) Sensor Info
                                                            13) Diagnostics
  Enter Option: 1                                                  Esc-Exit

Run

 This will start the sensor logging.
 Continue?  y   (y/n)
                                                                  Esc-Exit
```

Figure 3-12. Run Option

A very useful feature in the "***WATER*LOG**" Run Option, is the ability to specify a start time. This feature will allow you to manually select a start time in the next 24 hours. This may be used to start the logging process at midnight or some other desired time.

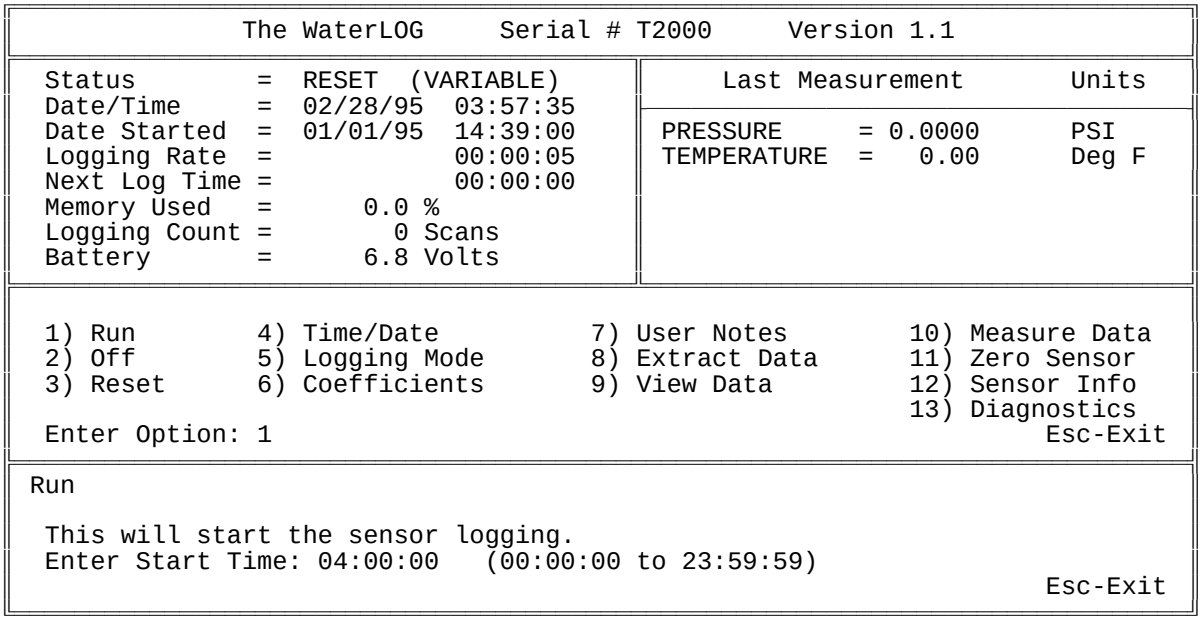

Figure 3-13. Run Option/ Start Time

There are several options which will not execute in the RUN mode of operation because they disrupt the logging process. These options are 4, 5, 10, and 13.

3.2.7 Off or Stop Logging Option

The sensor can be paused and the logging operation halted by entering the OFF mode. The OFF mode allows the execution of the options not allowed in the RUN mode except for option 13, which can only be executed in the RESET mode of operation. Figure 3-14 shows how the OFF mode is invoked. You must confirm this option by typing <y> to prevent inadvertent operation.

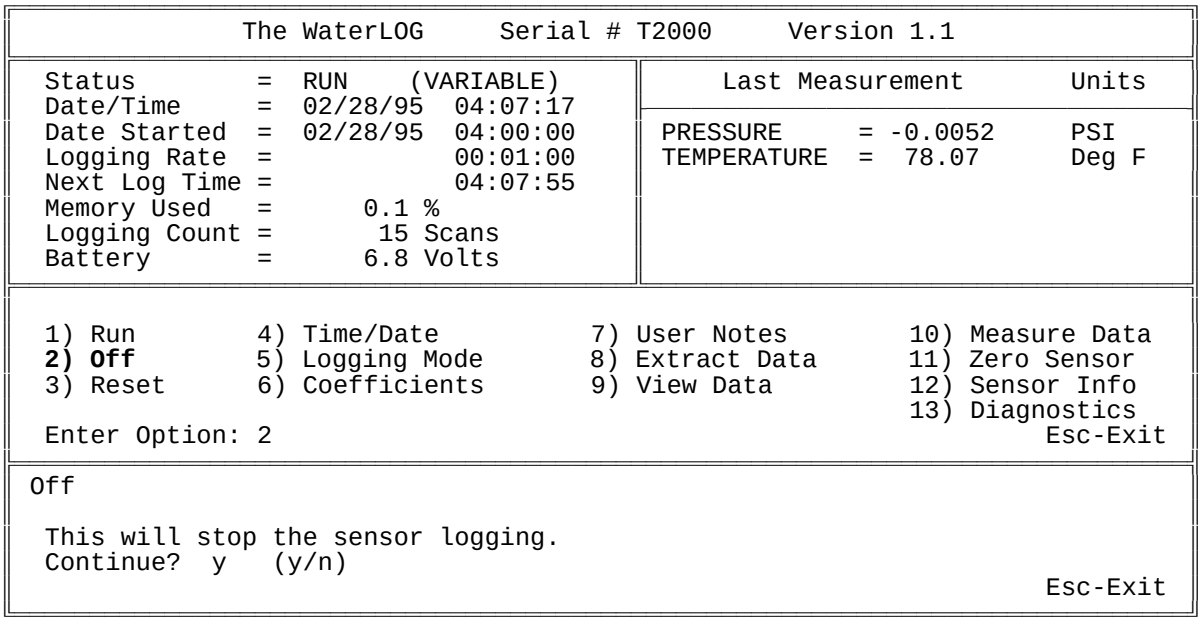

Figure 3-14. Stop Logging Option

3.2.8 Extract Data Option

You will use the Extract Data option to retrieve the data stored in the FLASH EEPROM of the "***WATER*LOG**" using option number 8 as shown in Figure 3-15. You can choose to transfer all the data stored in the "***WATER*LOG**" or transfer only the new data stored since the previous download.

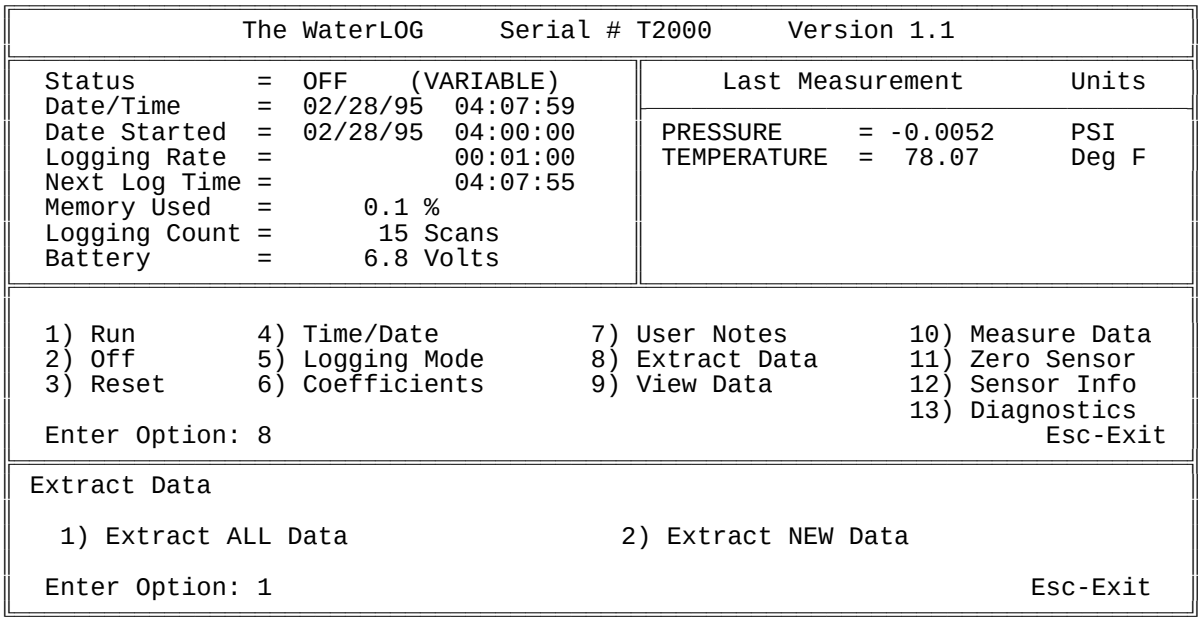

Figure 3-15. Extract Data Option

Shown in Figure 3-16, the software running in the computer will cause the "***WATER*LOG**" to transfer the data to the computer, and place the data in a user specified file. The file name can be up to 8 characters in length. The computer software will append a ".DAT" extension on the filename. The data from the "***WATER*LOG**" FLASH EEPROM will be placed in the specified file on the default disk drive.

```
              The WaterLOG     Serial # T2000     Version 1.1

  Status         =  OFF    (VARIABLE)          Last Measurement        Units
  Date/Time      =  02/28/95  04:08:46
  Date Started   =  02/28/95  04:00:00    PRESSURE     = -0.0052      PSI
  Logging Rate   =            00:01:00    TEMPERATURE  =  78.07       Deg F
  Next Log Time  =            04:07:55
  Memory Used    =      0.1 %
  Logging Count  =       15 Scans
  Battery        =      6.8 Volts


  1) Run         4) Time/Date          7) User Notes        10) Measure Data
  2) Off         5) Logging Mode       8) Extract Data      11) Zero Sensor
  3) Reset       6) Coefficients       9) View Data         12) Sensor Info
                                                            13) Diagnostics
  Enter Option: 8                                                   Esc-Exit

 Extract ALL Data
  Destination Filename:  myfile1
  (1 to 8 characters)
  Example : Logger10
```

Figure 3-16. Filename Input

Figure 3-17 shows a sample screen which is displayed during the Extract All Data process. This process can take several minutes when the FLASH EEPROM is full of data. The format of this file is described in chapter 5 "**Guide to Data Analysis**". You can see the percentage of completion as shown on the screen.

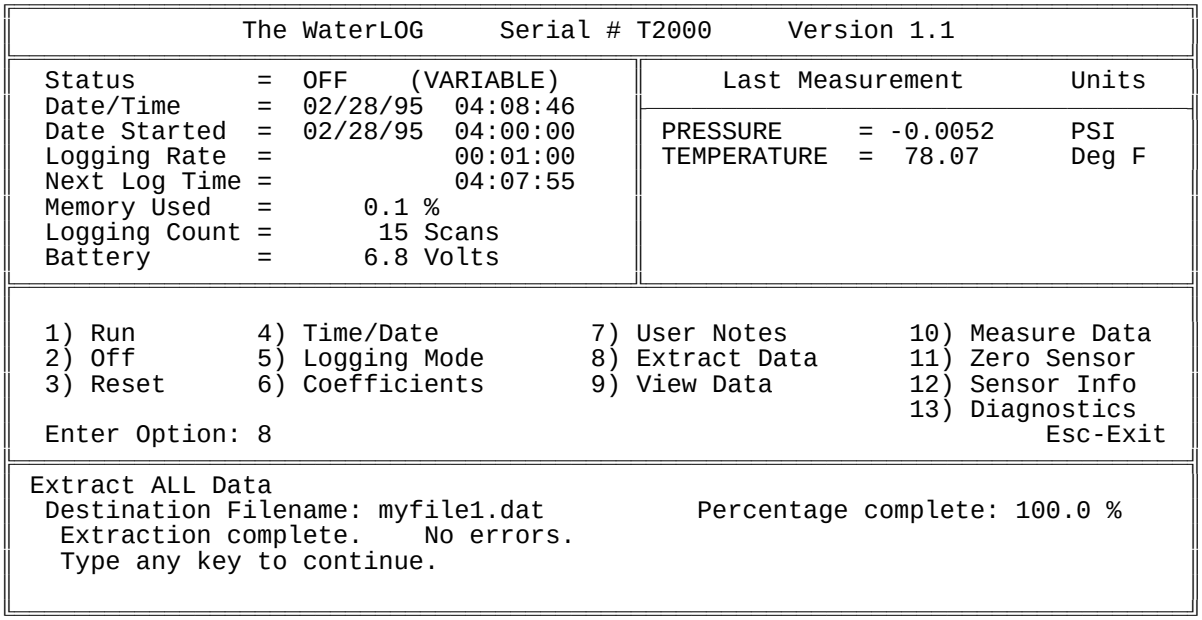

Figure 3-17. Extract ALL Data Option

Figure 3-18 shows a sample screen which is displayed during the Extract New Data process. This option extracts all data recorded since the last time you extracted data. You can see the percentage of completion as shown on the screen.

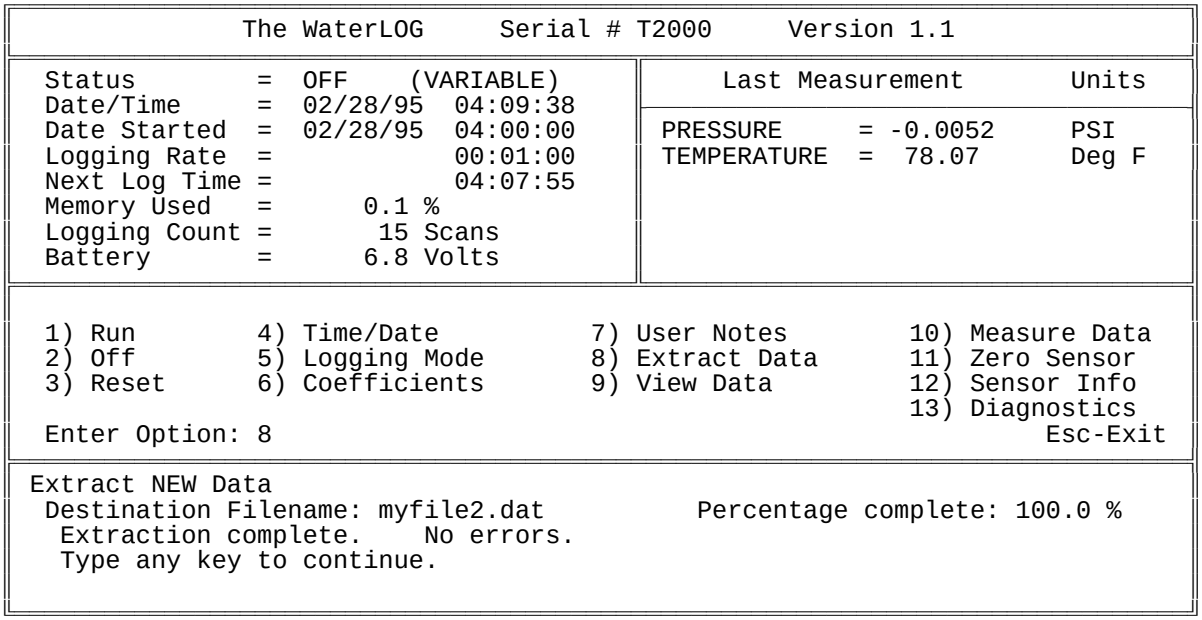

Figure 3-18. Extract NEW Data Option

Warning: If the power has failed in the "*WATER*LOG", the FLASH EEPROM will still contain the data sampled up to the time of the power failure. Power to the "*WATER*LOG" must be restored. Memory pointers will be initialized to the last location in the FLASH EEPROM. Therefore, extract data using menu option 8 before resetting the "*WATER*LOG".

3.2.9 View Data Option

You can examine the data stored in the FLASH EEPROM by selecting option number 9. The display will show Scan Number, Date, Time, Pressure, Temperature, and Battery Voltage as shown in Figure 3-19. Up to 16 samples can be displayed on the screen. If more than 16 samples are stored in memory, the "Home", "End", "PgUp", "PgDn", "↑", and "↓" keys can be used to move through the data. A Scan Number can also be entered to help you jump to a specific location in the data.

View WaterLOG Module

Scan #	Date	Time	Press(PSI)	Temp(Deg F)	Batt. Voltage
1	02/28/95	04:00:00	-0.0053	77.36	6.8
2	02/28/95	04:00:05	-0.0051	77.38	6.8
3	02/28/95	04:00:10	-0.0053	77.39	6.8
4	02/28/95	04:00:15	-0.0053	77.40	6.8
5	02/28/95	04:00:20	-0.0052	77.41	6.8
6	02/28/95	04:00:25	-0.0053	77.43	6.8
7	02/28/95	04:00:55	-0.0053	77.46	6.8
8	02/28/95	04:01:25	-0.0053	77.56	6.8
9	02/28/95	04:01:55	-0.0052	77.61	6.8
10	02/28/95	04:02:25	-0.0053	77.66	6.8
11	02/28/95	04:02:55	-0.0052	77.72	6.8
12	02/28/95	04:03:55	-0.0052	77.81	6.8
13	02/28/95	04:04:55	-0.0052	77.92	6.8
14	02/28/95	04:05:55	-0.0052	78.00	6.8
15	02/28/95	04:06:55	-0.0052	78.07	6.8

Enter Scan Number : 1 Home, End, PgUp, PgDn, ↑, ↓ Esc-Exit

Figure 3-19. View Data Display

3.2.10 Measure Data Option

The Measure Data Option causes the "***WATER*LOG**" to take a measurement as shown in Figure 3-20. The "***WATER*LOG**" makes the measurement and stores the results in the FLASHEEPROM. The software in the computer will then query the "***WATER*LOG**" for the measurement, which is displayed in the top right window of the screen.

```
              The WaterLOG     Serial # T2000     Version 1.1

 Status         =  OFF    (VARIABLE)        Last Measurement       Units
 Date/Time      =  02/28/95  04:11:27
 Date Started   =  02/28/95  04:00:00   PRESSURE     = -0.0052     PSI
 Logging Rate   =            00:01:00   TEMPERATURE  =  78.07      Deg F
 Next Log Time  =            04:07:55
 Memory Used    =      0.1 %
 Logging Count  =       15 Scans
 Battery        =      6.8 Volts


 1) Run         4) Time/Date          7) User Notes        10) Measure Data
 2) Off         5) Logging Mode       8) Extract Data      11) Zero Sensor
 3) Reset       6) Coefficients       9) View Data         12) Sensor Info
                                                           13) Diagnostics
 Enter Option: 10                                                Esc-Exit

Measure Data

  Type any key to make a measurement.
  (Data will be stored into Memory.)
                                                                 Esc-Exit
```

Figure 3-20. Measure Data Option

3.2.11 Zero Sensor Option

The "***WATER*LOG**" software allows you to force the sensor to use a specific point as its zero offset point. For example, placing the sensor in 5 feet of water and pressing option number 11 will cause the sensor to record levels with a -5.0 foot offset. Figure 3-21 shows the option selected. Note: This option requires a "Y" or "N" conformation before it proceeds.

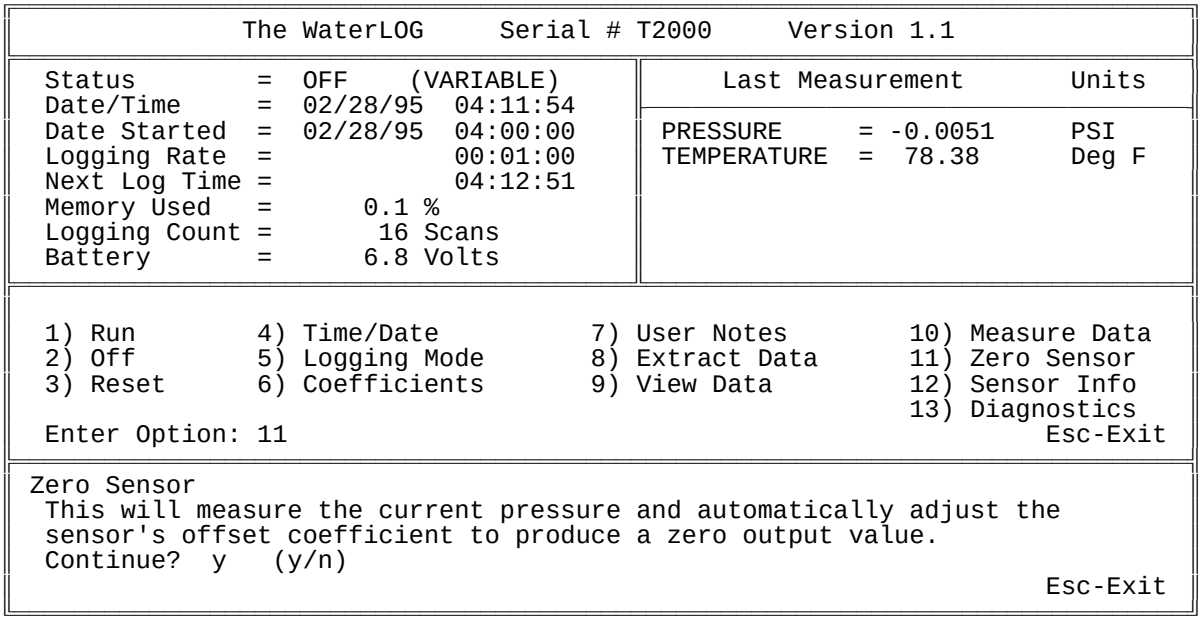

Figure 3-21. Zero Sensor Option

The Zero Sensor option can also be used periodically to remove errors in pressure due to long-term drift. To do this, remove the "***WATER*LOG**" from the water and allow it to settle for about 20 minutes (The sensor temperature will likely be changing rapidly so you must allow it to settle). Issue the Zero Sensor option and the pressure output will go to very near 0.0000.

3.2.12 Sensor Information Option

You can see information about your "***WATER*LOG**" sensor by invoking option number 12 as shown in Figure 3-22. The Vendor, Model Number, Firmware Version, Printed Circuit Board Serial Number, Product Serial Number, and Product Revision number are available for technical support purposes.

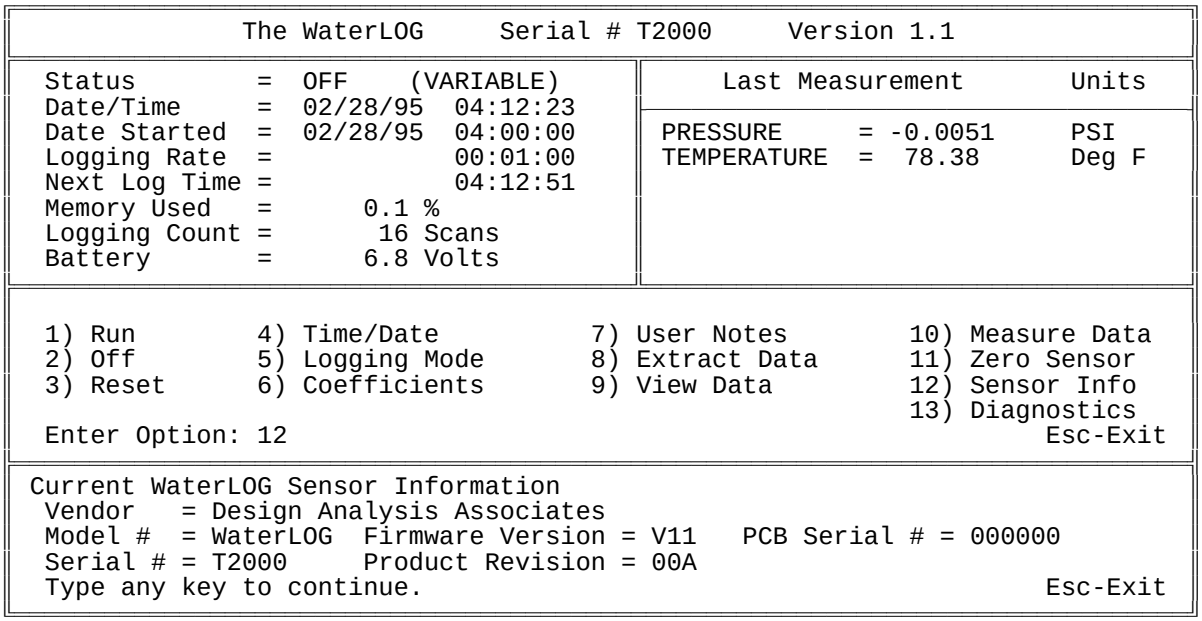

Figure 3-22. Read Sensor Information Option

3.2.13 Diagnostics Option

The Diagnostics option, as shown in Figure 3-23, performs several tests on the hardware of the "***WATER*LOG**" sensor. This option is used to confirm that the sensor is working properly. The sensor must be in the reset mode before this option can be selected.

Note: Time, Date, User Notes and ALL DATA will be overwritten during this test. Extract any desired data before using this option.

```
              The WaterLOG     Serial # T2000     Version 1.1

  Status         =  RESET  (VARIABLE)      Last Measurement       Units
  Date/Time      =  02/28/95  04:13:02
  Date Started   =  02/28/95  04:00:00   PRESSURE     = -0.0051     PSI
  Logging Rate   =            00:01:00   TEMPERATURE  =  78.38      Deg F
  Next Log Time  =            04:12:51
  Memory Used    =       0.0 %
  Logging Count  =         0 Scans
  Battery        =       6.8 Volts


  1) Run         4) Time/Date          7) User Notes        10) Measure Data
  2) Off         5) Logging Mode       8) Extract Data      11) Zero Sensor
  3) Reset       6) Coefficients       9) View Data         12) Sensor Info
                                                            13) Diagnostics
  Enter Option: 13                                                Esc-Exit

 Diagnostics
  This hardware diagnostic overwrites
  time, date, user notes, and logged data.
  Continue?  y   (y/n)
```

Figure 3-23. Diagnostics Option

Figure 3-24 and Figure 3-25 show the results of the diagnostics. The first line tests the CONFIG register to see if the processor's COP timer is enabled. The diagnostics software in the "***WATER*LOG**" then checks the program EEPROM memory for a correct checksum. The software then tests the RAM Memory, FLASH EEPROM memory, EEPROM user notes, and performs a measurement that returns pressure, raw pressure voltage, temperature, and raw temperature voltage. The results of the tests will be shown on the screen. After the tests have completed, you can press any key to return to the main menu.

```
                      WaterLOG  Self Diagnostics

  CONFIG Register = 09: PASSED
  Starting EPROM checksum test
    EPROM checksum test: PASSED
  Starting Clock Test
    Set New Time: 23:59:59
    Wakeup Time: 00:00:04
    WaterLOG is going to sleep for 5 seconds
    WaterLOG is now awake: PASSED
  Starting RAM test
    Pattern test a RAM location to verify data bus
    Load odd-length pattern into RAM to verify address bus
    Verify odd-length pattern in RAM
    RAM test: PASSED
  Starting FLASH test
    Load odd-length pattern into FLASH to verify address bus
    Verify odd-length pattern in FLASH
    Load zeros into FLASH
    Verify zeros in FLASH

                                                              Esc-EXIT
```

Figure 3-24. Self-Test Diagnostic Display

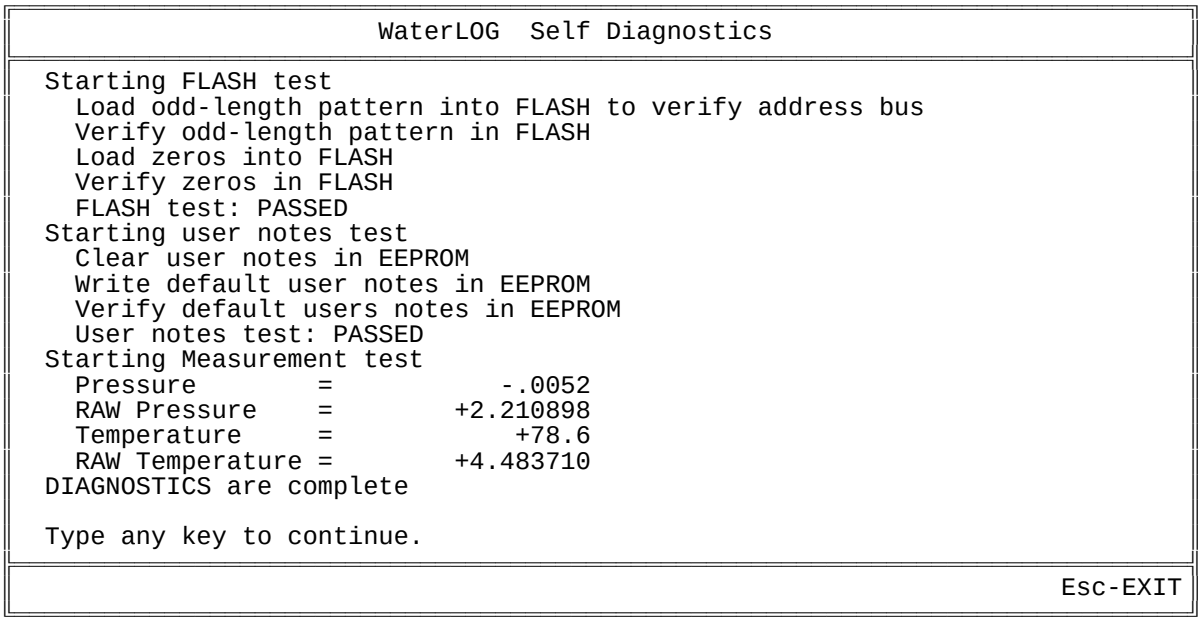

Figure 3-25. Self-Test Diagnostic Display

Chapter 4
Using the Graphical "*WATER*LOG" Software

4.1 Software Overview and Installation

This chapter explains the various menu screens you see when running the "***WATER*LOG**" software from a hard disk on a PC or laptop computer. The minimum requirements to run the software program is a 80386 processor with 4 Megabytes of RAM and a VGA Monitor. A bus mouse or a serial mouse on a COM port 1 greatly assists in working with this software, and using a color VGA monitor will enhance the graphics.

The user software program WATERLOG.EXE contains menus which are used to control the "***WATER*LOG**". This guide shows a step-by-step run-through of the options. This guide does not necessarily show a sequence of operations necessary to do everything which might be desired, but it is a guide through each menu item to familiarize you with the capabilities of the "***WATER*LOG**". Menu options can later be invoked in the order needed to satisfy your requirements.

4.2 Invoking WATERLOG.EXE

For best performance, we recommend loading the software to a hard drive. This can be done by typing the following: (this assumes that the hard disk is the C drive and the floppy drive is A, change these as needed).

```
C:\>cd \
C:\>md WATERLOG
C:\>cd WATERLOG
C:\WATERLOG>copy a:*.* c:
```

To run the program, just type "WATERLOG" at the DOS prompt. If it does not run, make sure you are in the right directory. Type:

```
C:\>cd \
C:\>cd WATERLOG
C:\WATERLOG>WATERLOG
```

If you have problems communicating with the "***WATER*LOG**", type the following to get the command line options for the software.

```
WATERLOG ?
```

The following will be displayed on the screen:

Wrong number of parameters have been specified.

WATERLOG <STAND> <COM> ; < > = Optional
DEFAULT : (STAND = 1, COM = 2)
STAND: 1 = CONNECT
2 = STAND-ALONE
3 = STAND-ALONE ONLY
COM : 1 = COM1
2 = COM2

Example 1:
WATERLOG
Uses defaults (CONNECT) (COM2)

Example 2:
WATERLOG 2 1
Uses user defined (STAND-ALONE) (COM1)

Note: WATERLOG.EXE uses the standard IBM PC serial port interrupt configuration; IRQ4 for COM1 and IRQ3 for COM2.

The master disk contains several files. The list below shows all the files that are required to run the program except for the *.HLP files. The *.HLP files are the help files and if not present, will prevent any on line help.

WATERLOG.EXE	; main program
DOS4GW.EXE	; program to use upper memory
PMINFO.EXE	; diagnostic program to see memory usage
WATERLOG.WSF	; sample "***WATER*LOG**" setup file
TEST.DAT	; sample data file
FNT8X8.BIN	; font file
*.HLP	; help files (27)

4.3 Overview of Options

The screen of the computer is updated every 5 seconds with the logger time, date and sensor data. When the ***WATER*WARE™** program is running, it issues a command to the "***WATER*LOG**" telling it to provide the information displayed on the next screen update. When connected to the "***WATER*LOG**" and running the ***WATER*WARE™** program, the "***WATER*LOG**" will change to a continuous operating-power mode from the low-power mode to be able to respond to commands from the computer. This continuous operation shortens battery life and should not be used for long periods in the field unless you are willing to replace the battery more frequently. However, an external 12 volt power source can be connected via the RS-232 communications connector to elevate power drain on internal lithium battery pack.

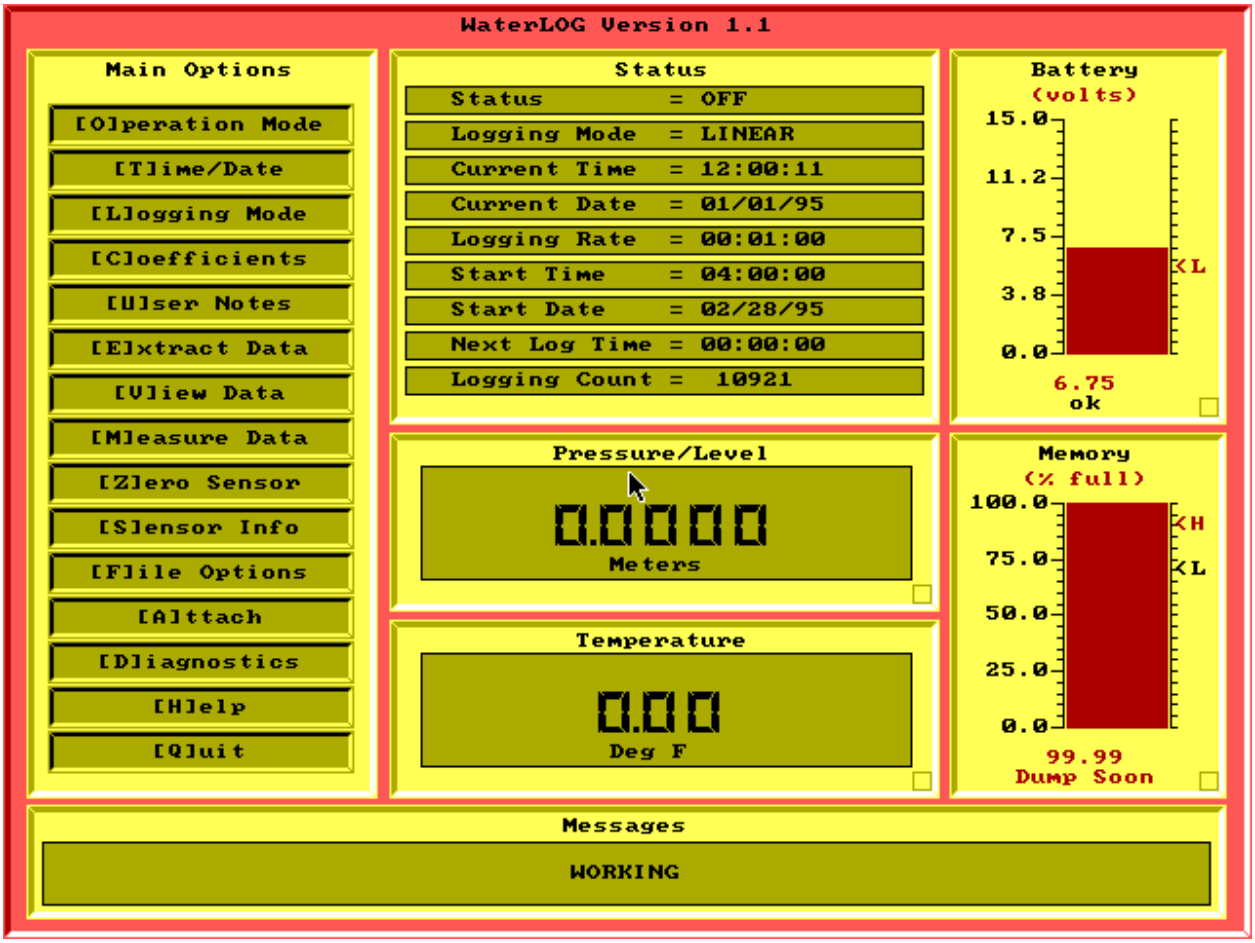

Figure 4-1. Master Menu Screen

Figure 4-1 shows the master menu screen. This screen is divided into seven sections. The function of each section is described as follows:

Battery Window:

The Battery window shows the status of the "***WATER*LOG**" battery. This will be updated about every 5 seconds while the sensor is "Attached". The bar graph gives a quick visual indication of the battery status and the number below the graph gives the actual voltage. If the battery voltage is below 5.5 volts, a warning message will be displayed at the bottom of the window. Normal operating voltage for the internal battery is between 5.5 volts and about 7 volts. If an external battery is used, it could be as high as 16 volts but must not exceed this level. This window can be moved and resized if needed.

Memory Window:

The Memory window shows the status of the data memory as a percent of being full. This will be updated about every 5 seconds while the sensor is "Attached". The bar graph gives a quick visual view of how full the data memory is. The number below the graph is the actual percent full. As the memory fills, warning messages will be displayed at the

bottom of the screen. When the memory is above 70% full, the message will show "Filling Up", and at 90% the message will be "Dump Soon". If the memory becomes full, the sensor will continue to log data but the oldest data will be overwritten and lost. This window may be moved and resized.

Status Window:

The status window lists several items pertaining to the operation of the sensor when one is "Attached" and other information when a sensor is not attached.

Line 1, Status:

This indicates what mode the software and sensor are in.

Stand-Alone Mode:

This mode indicates that the software is running independently of the sensor. A logger may be physically connected but not "Attached" by software.

Reset Mode:

The sensor is attached and has been reset. All data memory has been cleared and ready to log new data.

Run Mode:

The sensor is attached and is logging data to memory.

Off Mode:

The sensor is attached and logging is suspended. Data is still in memory, and if logging is restarted, the new data will be appended to the old data.

Line 2, Logging Mode:

This line shows the logging mode. If a sensor is attached, it is the logging mode of the sensor. If no sensor is attached, it is the mode defined by the software options. The logging modes are Linear, Delta, Hyper, Hyper/Delta, and Variable. (See section 4.4.3 for definitions of each logging mode)

Line 3, Time:

If a sensor is attached, this is the time in the sensor. If a sensor is not attached, this is the PC time. This will update every second with no sensor attached and every 5 seconds with a sensor attached.

Line 4, Date:

If a sensor is attached, this is the date in the sensor. If a sensor is not attached, this is the PC date. This will be updated about every 5 seconds.

Line 5, Logging Rate:

The logging rate is a time from 1 second to 24 hours in the form of 00:00:01 to 24:00:00. This is how often the sensor will log data.

Line 6, Start Time:

The start time shows when the sensor started to log data. If no sensor is attached, this line is not valid and NA will be displayed.

Line 7, Start Date:

The start date shows when the sensor started to log data. If no sensor is attached, this line is not valid and NA will be displayed.

Line 8, Next Log Time:

This line shows the time when the sensor is to make the next measurement. This will be within 24 hours. If no sensor is attached, this line is not valid and NA will be displayed.

Line 9, Logging Count:

This line shows the number of data points logged. When the unit is reset, this will be cleared out to 0 logs. When logging is started, this will increment each time the sensor logs data. If logging is stopped and later restarted without going through reset, this number will continue where it left off. If the data memory fills up and the sensor starts overwriting old data, the log counts continue to increment even though some of the data is no longer present. The maximum count is 10,922 counts with a 128 K bytes FLASH EEPROM installed. If a sample is taken every hour, the "***WATER*LOG**" will store 10,922 hours worth of data. Dividing 10,922 hours by 24 provides 455 days of sampling.

Pressure / Level Window:

The Pressure / Level window is a larger numeric display of the pressure reading converted to the desired units. This may be a raw pressure like PSI or converted to a level like feet or inches. This window may be moved and resized.

Temperature Window:

The Temperature window is a larger numeric display of the temperature reading converted to the desired units. This may be in Fahrenheit, Celsius, or user defined units. This window may be moved and resized.

Message Window:

Any status or warning messages that need to be shown will be displayed in the message window.

Main Options Window:

The main option buttons allow full control of the sensor when it is connected, and the ability to generate setup files in a stand-alone mode. The options can be selected by using the mouse and clicking on the desired button or by pressing the key placed in the brackets [ ]. **Use of this software does not required a mouse.** Using the keyboard you can perform all the functions of the mouse.

[O]peration Mode:

When attached to a sensor, this option is used to change the mode of operation. Run, Off, and Reset are valid operation modes.

[T]ime/Date:

When attached to a sensor, this option is used to set the time clock in the sensor.

[L]og Mode:

This option is used to set up the logging mode. Logging modes include Linear, Delta, Hyper, Hyper / Delta, and Variable.

[C]oefficients:

This option is used to set up the units for the pressure and temperature readings.

[U]ser Notes:

This option is used to enter general text into the data file. The information entered is up to you and normally includes information pertaining to the site.

[E]xtract Data:

When connected to a sensor, this option is used to get the data out of the sensor and into a data file on the PC.

[V]iew Data:

This option is used to view the data in a tabular format or as a graph. The data can be from a data file on the PC, or if a sensor is attached, the data can come from the sensor.

[M]easure Data:

This option is used to force an attached sensor to make a measurement. This may be used for testing the sensor during installation.

[Z]ero Sensor:

This option will force the sensor to use a specific point as its zero point offset. For example, placing the sensor in 5 feet of water and pressing the "Zero Button" will cause the sensor to record levels with a -5.0 foot offset. The logged value is based on the following equation:

Logged Level = True Level - Offset

All components of the equation must use the same units such as feet.

This option also allows you to easily remove any error in the pressure measurement due to long-term offset drift.

[S]ensor Info:

This option is used to view specific sensor information not related to the operation of the unit. This includes serial numbers and model numbers.

[F]ile Options:

This option is used to save and retrieve setup files. If a sensor is attached and a setup file is retrieved, the setup file will be loaded into the PC and into the attached sensor.

[A]ttach:

If a sensor is physically connected to the PC, this option is used to set up the software to communicate with the sensor.

[D]iagnostics:

This option is used to perform tests on an attached sensor. This will clear out the data memory, user notes and some other options. This is normally used only if there seems to be a question on the performance of the sensor.

[H]elp:

This is the top level help file for the main display.

[Q]uit:

This is used to exit the program and return to DOS.

Window Options:

Many of the windows throughout this software will have a small box in one or more of the corners. Using the mouse to click on the small box will cause the window to perform some function like close or resize.

Box in lower right corner:

When there is a small box in the lower right corner, it is used to resize the box. Click on the box and drag it to resize the box. Most boxes that have this option can also be moved by clicking on the window title and dragging the box to a new location.

Box in upper right corner:

When there is a small box in the upper right corner, it is used to maximize the window or display the window using the whole screen. Clicking on the box will maximize it. If a window has been maximized, clicking on the box again will return it to its normal size.

Box in upper left corner:

When there is a small box in the upper left corner, it is used to close the window. Clicking on the box will close it.

Moving windows to different locations:

All of these windows may be moved by using the mouse to click on the window name and dragging the window to the desired location.

Keyboard Options:

The keyboard can also be used to activate all functions within the program. When the button has a label on it like "[O]peration Mode", you can press a "O" or "o" on the keyboard to select "Operation Mode". The "TAB" key is used to jump between boxes and the "OK", "CANCEL", "HELP" buttons. Within a box, the "↑" and "↓" keys are used to highlight the selection wanted. Press the "SPACE" key to confirm your selection. Then use the "TAB" key to highlight the "OK" button and press <ENTER>. The combination of these keys will allow you to run the program without a mouse.

4.4 Main Options

4.4.1 Operation Mode

The Operation Mode has three options; Reset Sensor, Stop Logging and Start Logging.

4.4.1.1 Reset Option

Figure 4-2 shows a sample screen of when the "***WATER*LOG**" sensor is first installed. The first option that you should invoke is "Operation Mode" Reset. Place the mouse cursor over the "Operation Mode" button and press the left mouse button. Place the mouse cursor over the "( )" in front of Reset Sensor and press the left mouse button. Then Click on the "OK" button to continue the command. You will be notified that all data will be erased and the sensor will be reset. Click on the "OK" button to acknowledge the message.

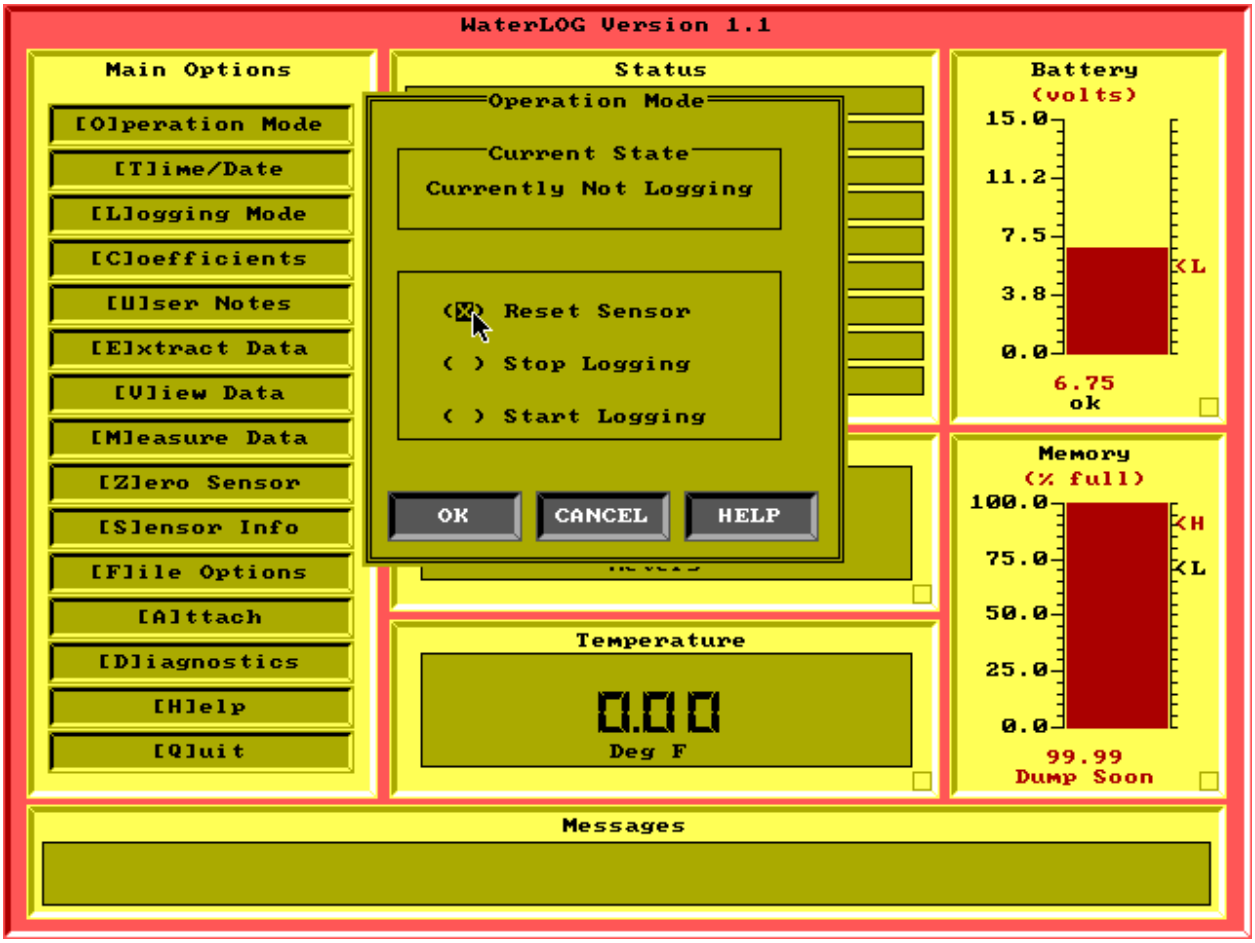

Figure 4-2. Reset Option

Figure 4-3 shows the same screen as Figure 4-2 except the Operation Mode box has been moved down to uncover the status section on the main screen. To move the Operation Mode box to a different location on the screen, put the mouse arrow on top of the words Operation Mode and hold down the left mouse button. While holding down the left mouse button, move the mouse to a different location on the screen. The Operation Mode box should follow the mouse to a new location on the screen.

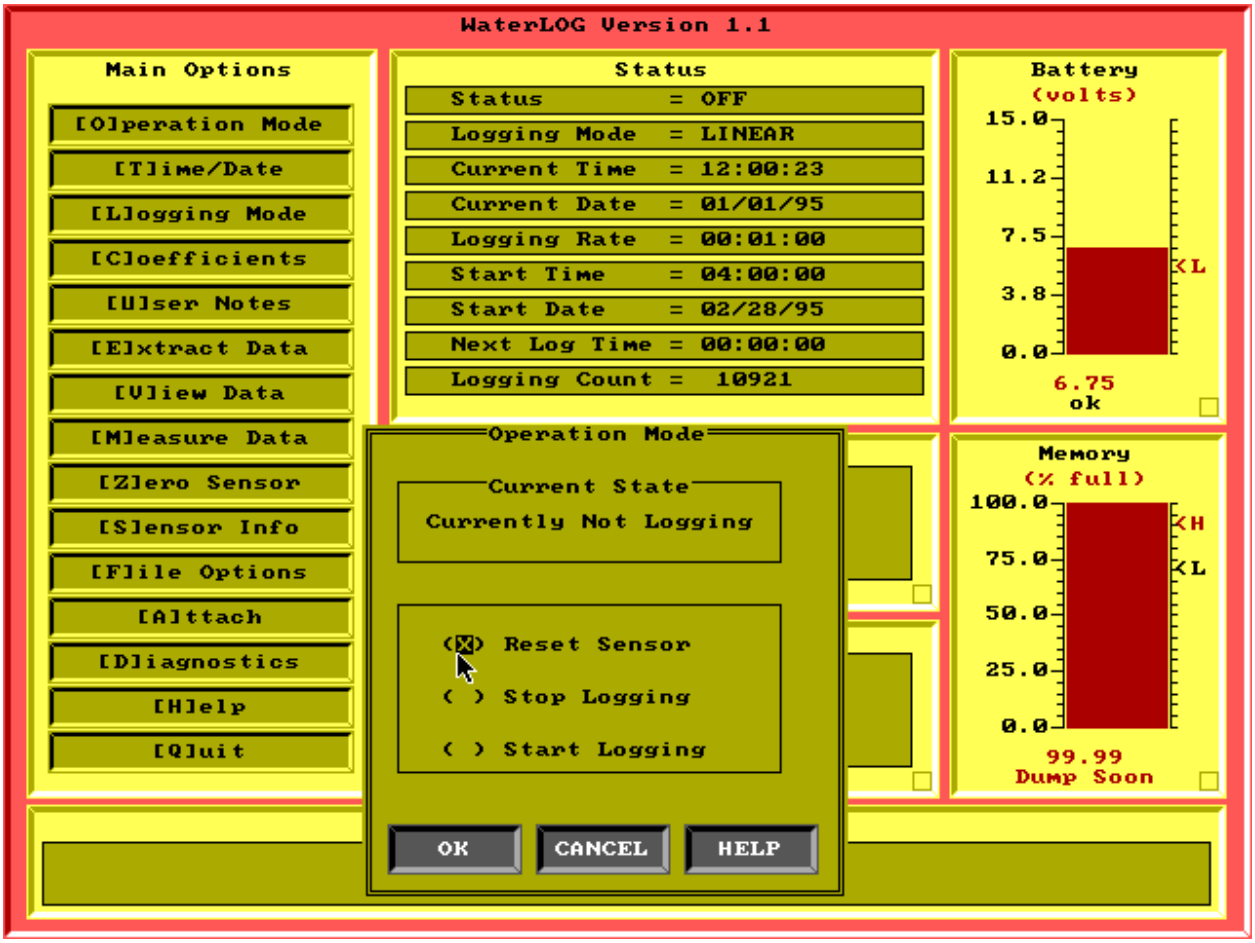

Figure 4-3. Reset Option with Operation Mode Box Moved

Warning : This option should not be invoked if there is data in the FLASH EEPROM which needs to be extracted. In the event of a dead battery, the memory pointers in the "***WATER*LOG**" will point to the last location in memory. Therefore, you can extract data by clicking on the "Extract Data" button before resetting the "***WATER*LOG**".

4.4.1.2 Stop Logging Option

The sensor can be paused and the logging operation halted by entering the OFF mode. The OFF mode allows the execution of the options not allowed in the RUN mode except for Time/Date and Diagnostics, which can only be executed in the RESET mode of operation. Figure 4-4 shows how the OFF mode is invoked. You must confirm this option by clicking on the OK button to prevent inadvertent operation.

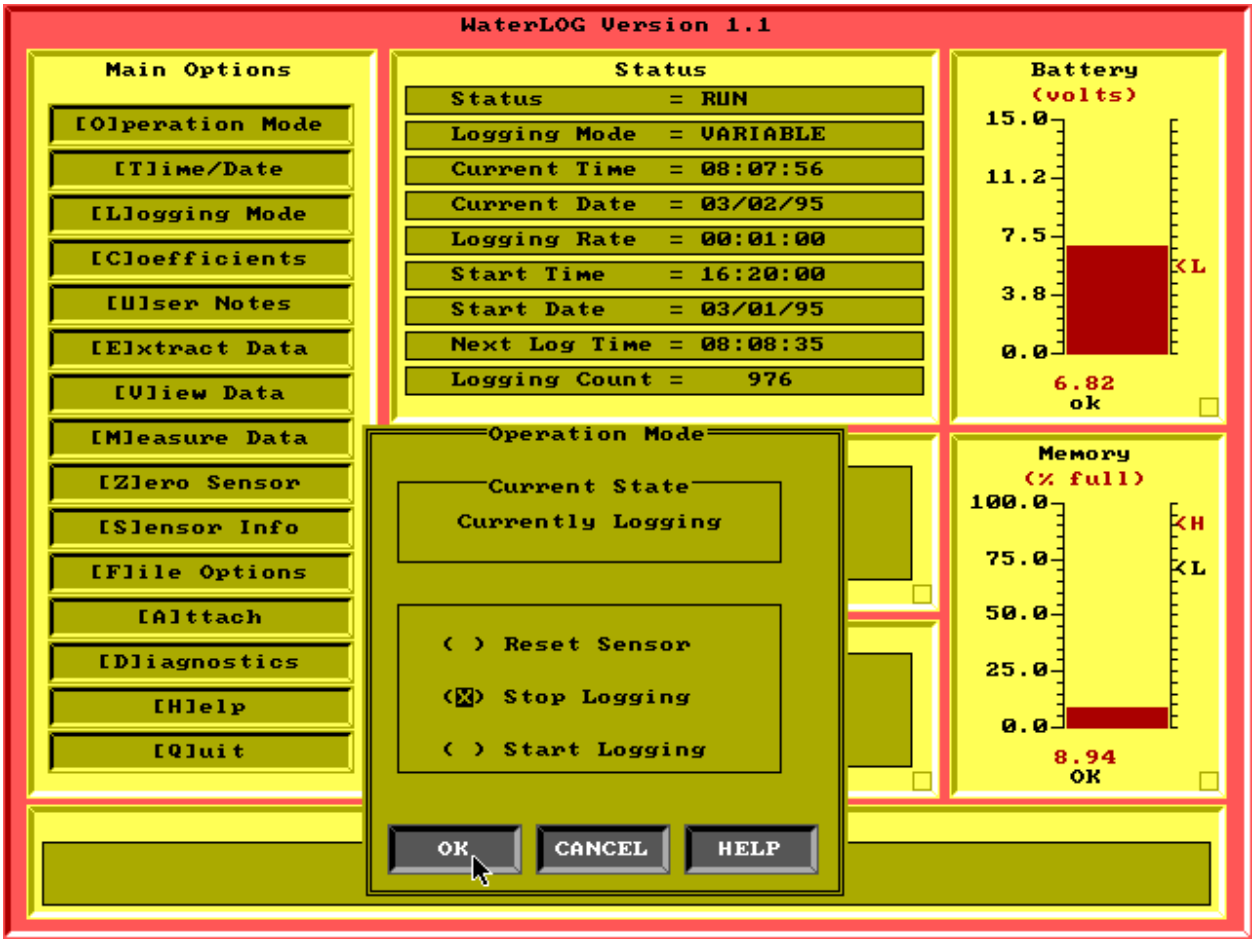

Figure 4-4. Stop Logging Option

4.4.1.3 Start Logging or RUN Option

In the RUN mode of operation, the "***WATER*LOG**" will make measurements at an interval set by the Logging Option specified in Logging Mode. The data from the samples will be stored in the FLASH EEPROM in the "***WATER*LOG**". The "***WATER*LOG**" will enter a low-power mode of operation to conserve battery power during the wait times. You can cause the "***WATER*LOG**" to enter the RUN mode shown in Figure 4-5 by selecting the Operation Mode button. You will be asked to verify the selection to prevent inadvertent operation.

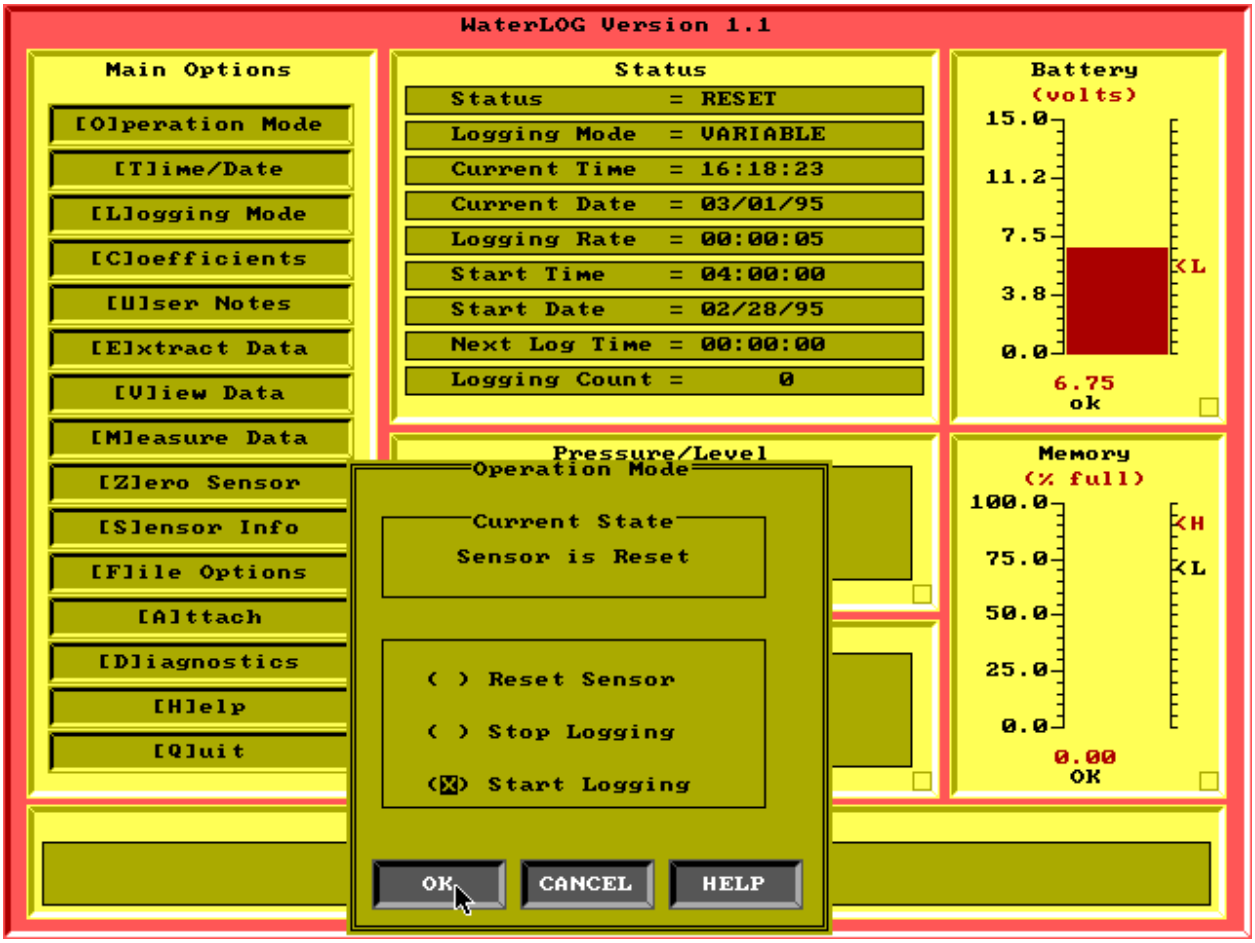

Figure 4-5. Run Option

In the Run Option, a start time can be specified. This will allow you to manually select a start time in the next 24 hours. This may be used to start the logging process at midnight or some other desired time.

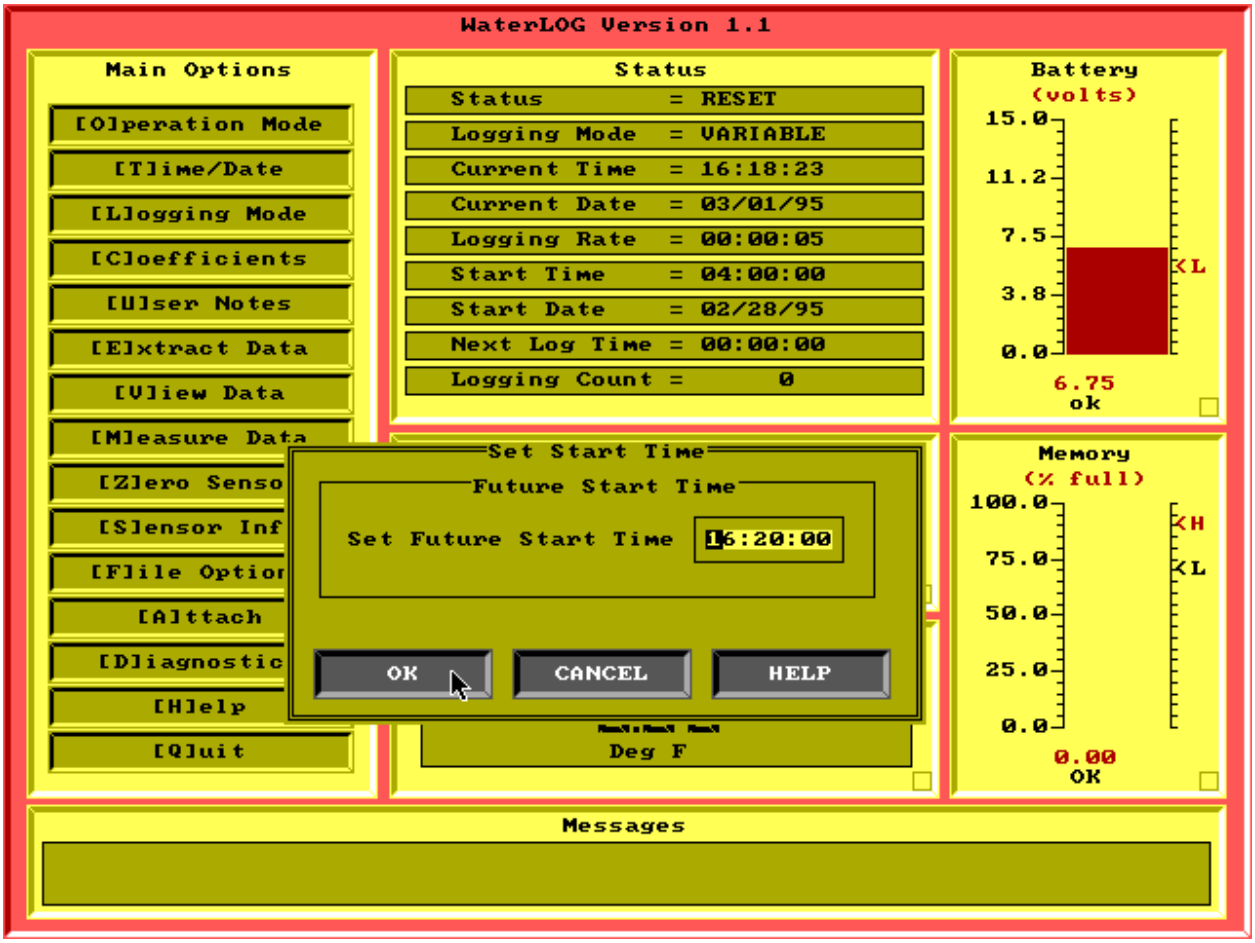

Figure 4-6. Run Option/ Start Time

With the "***WATER*LOG**" in the RUN mode, you can disconnect the interface cable to the sensor and it will continue to operate in the run mode until manually disabled or the battery power is lost. The batteries are designed to operate the unit for up to five years depending on the sample rate.

There are several options which will not execute in the RUN mode of operation because they disrupt the logging process. These options are Time/Date, Logging Mode, Measure Data, and Diagnostics.

4.4.2 Time/Date Option

Changing the time and date is shown in Figure 4-7. The correct date and time must be typed in the format shown below:

Time	(HOUR:MINUTE:SECOND)	range is (00:00:00 to 23:59:59)
Date	(MONTH:DAY:YEAR)	range is (01/01/00 to 12/31/99)

This date and time are stored in the "***WATER*LOG**". The clock circuitry in the "***WATER*LOG**" is powered from the main battery of the "***WATER*LOG**". If the "Sync to PC Clock" option is selected, the time and date shown will be ignored and the PC clock will be used to set the clock on the "***WATER*LOG**". This is used to easily synchronize multiple "***WATER*LOG**" Sensors to the same time.

You should always invoke the Reset and Time/Date options whenever the battery is changed. Any data should be extracted before changing the battery or resetting the "***WATER*LOG**".

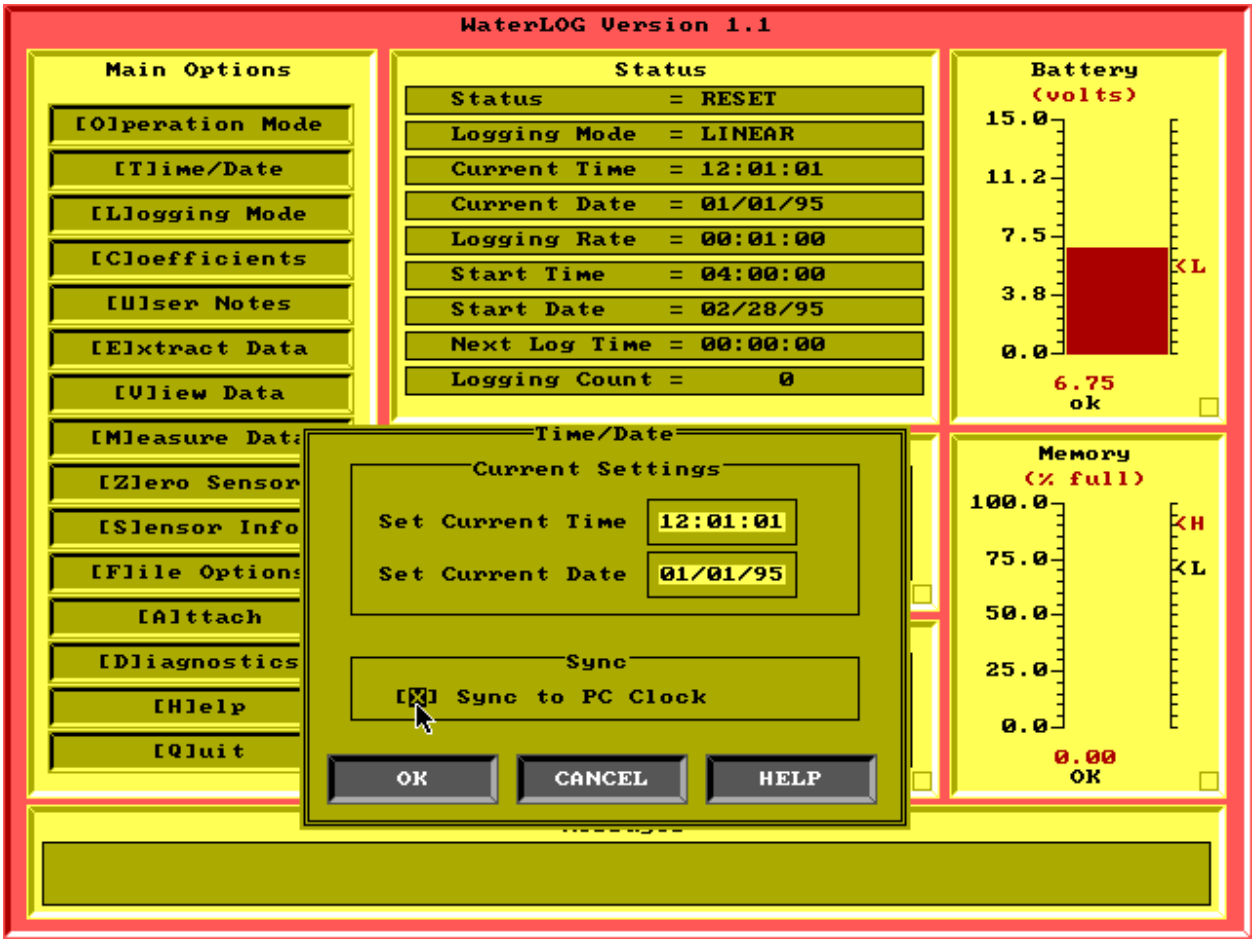

Figure 4-7. Time/Date Option

4.4.3 Logging Mode Option

Logging Mode, Coefficients, and User Notes configure the "***WATER*LOG**" for an unattended logging session. The Logging Mode Option is shown in Figure 4-8. The logging rate indicates the elapsed time between measurements. The "***WATER*LOG**" clock circuitry allows the "***WATER*LOG**" to enter a low-power "SLEEP" mode of operation between measurements. When the time interval has elapsed, which is specified in Logging Mode, the "***WATER*LOG**" will "WAKE-UP" and take a pressure, temperature and battery voltage measurement. It will then store the data in FLASH EEPROM with a time-stamp, and then go to "SLEEP" again.

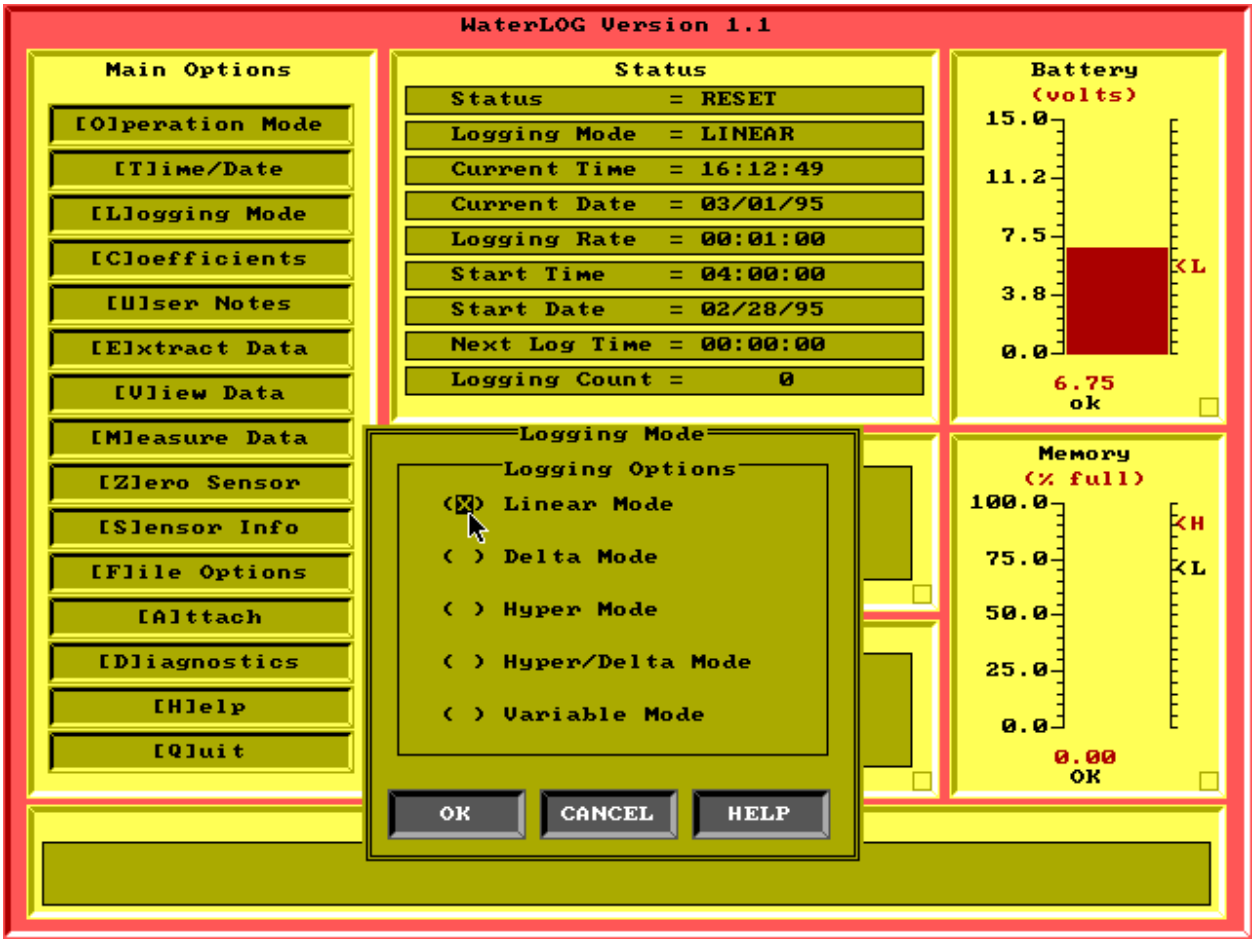

Figure 4-8. Logging Mode Option

The time between samples will range from 1 second up to 24 hours. If the logging rate is less than 6 seconds, the "***WATER*LOG**" when running, will not go to "SLEEP".

The "***WATER*LOG**" "WAKES-UP" and takes a measurement when the time in the DATE/TIME field matches the "Next Log Time". The "Next Log Time" is incremented by the logging rate. If the new "Next Log Time" has already occurred, the "***WATER*LOG**" will continue to add the

logging rate to the new Next Log Time until the new Next Log Time is in the future. Then the "***WATER*LOG**" will "WAKE-UP" to take the next sample.

There are five different modes the "***WATER*LOG**" sensor can operate under. Each Logging Mode is briefly explained below:

Linear Mode:

The Linear Mode is the simplest and allows the sensor to log data at a set time interval from once a second to once a day. Linear Mode is shown in Figure 4-9.

Delta Mode:

The Delta Mode is like the Linear Mode with the addition of not logging data if the data is not changing. Delta Mode is shown in Figure 4-10.

Hyper Mode:

The Hyper Mode is like the Linear Mode with the addition of the ability to speed up the logging rate based on the data rate of change. Hyper Mode is shown in Figure 4-11.

Hyper-Delta Mode:

The Hyper-Delta Mode is just as it sounds, a combination of the Hyper Mode and the Delta Mode. Hyper-Delta Mode is shown in Figure 4-12.

Variable Mode:

The Variable Mode provides 6 time periods to be set up with different logging rates. The length of the time periods can also be adjusted. This Logging Rate can be used to simulate a logarithmic logging function. Variable Mode is shown in Figure 4-13.

4.4.3.1 Linear Logging Mode Option

The Linear Logging Mode shown in Figure 4-9 is configured to have a constant time between each measurement. All that is needed to set up this mode is to select a logging rate from the list. The current logging rate is the top item in the list. The scan rate list will provide several preset intervals from once a second to once a day. Select the appropriate logging rate and click on the "OK" button to program the "***WATER*LOG**" with the desired interval.

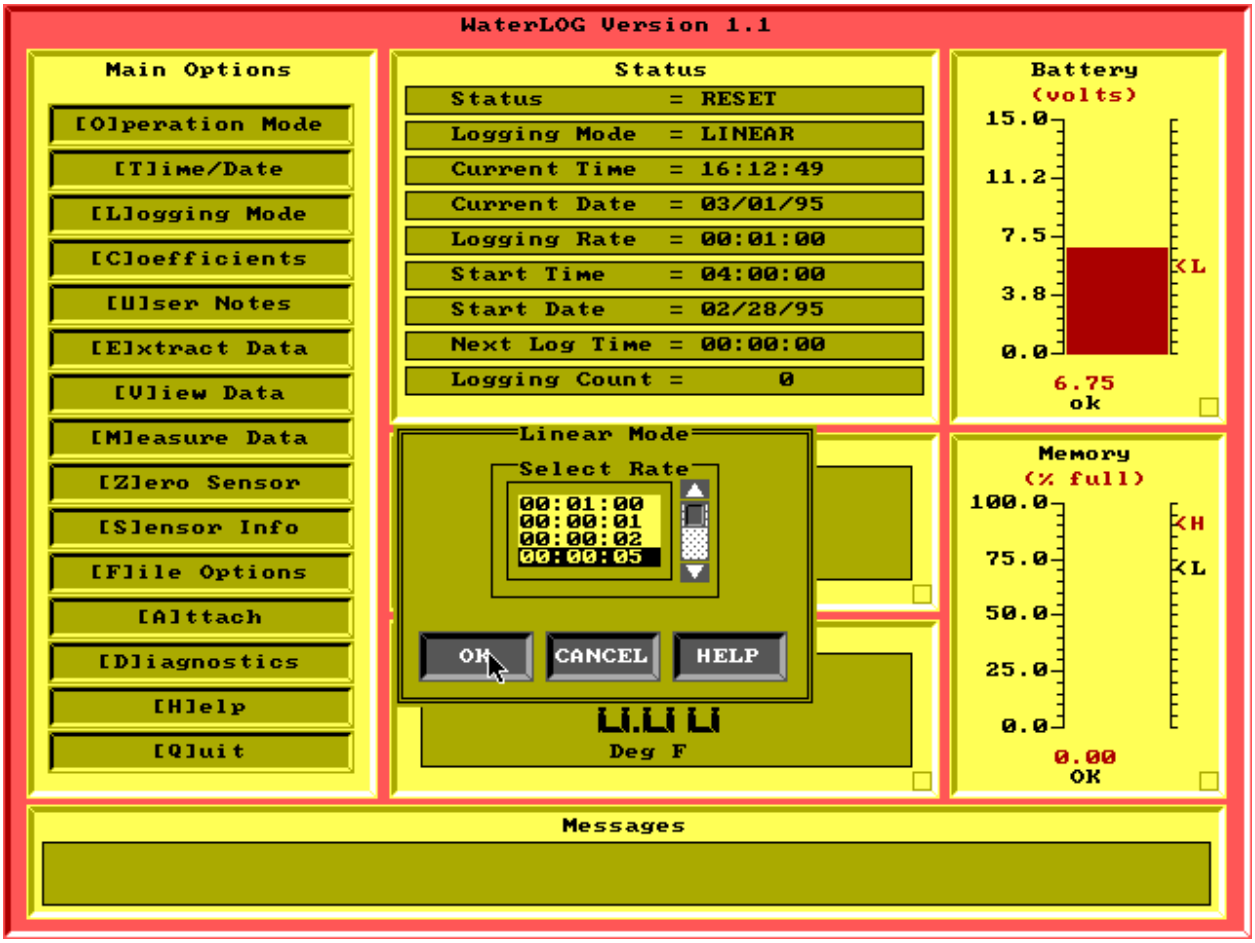

Figure 4-9. Linear Mode Option

4.4.3.2 Delta Logging Mode Option

The Delta Logging Mode shown in Figure 4-10 provides the means to log data only if it is changing more than a set limit.

Logging Rate:

This is just like in the Linear Mode.

Delta Limit:

The Delta Limit sets the point that determines if the scanned data is to be logged or not. Each time the sensor takes a reading, it will compute the absolute difference between this reading and the last logged reading. If the difference between the new value and the last logged value is less than the delta limit, the sensor will not log the new data. If the difference between the scanned value and the last logged data is greater than the delta limit, the new data will be logged.

This option is handy for saving memory space since data is not logged if the data does not change more than the delta limit. You must decide how much change in level can happen before the sensor logs the data. Note that this check is on the level parameter only, not the temperature, and the value entered will be in the same units as set in the coefficients options. For example, if the coefficient units are set to feet, the delta limit will be in feet also.

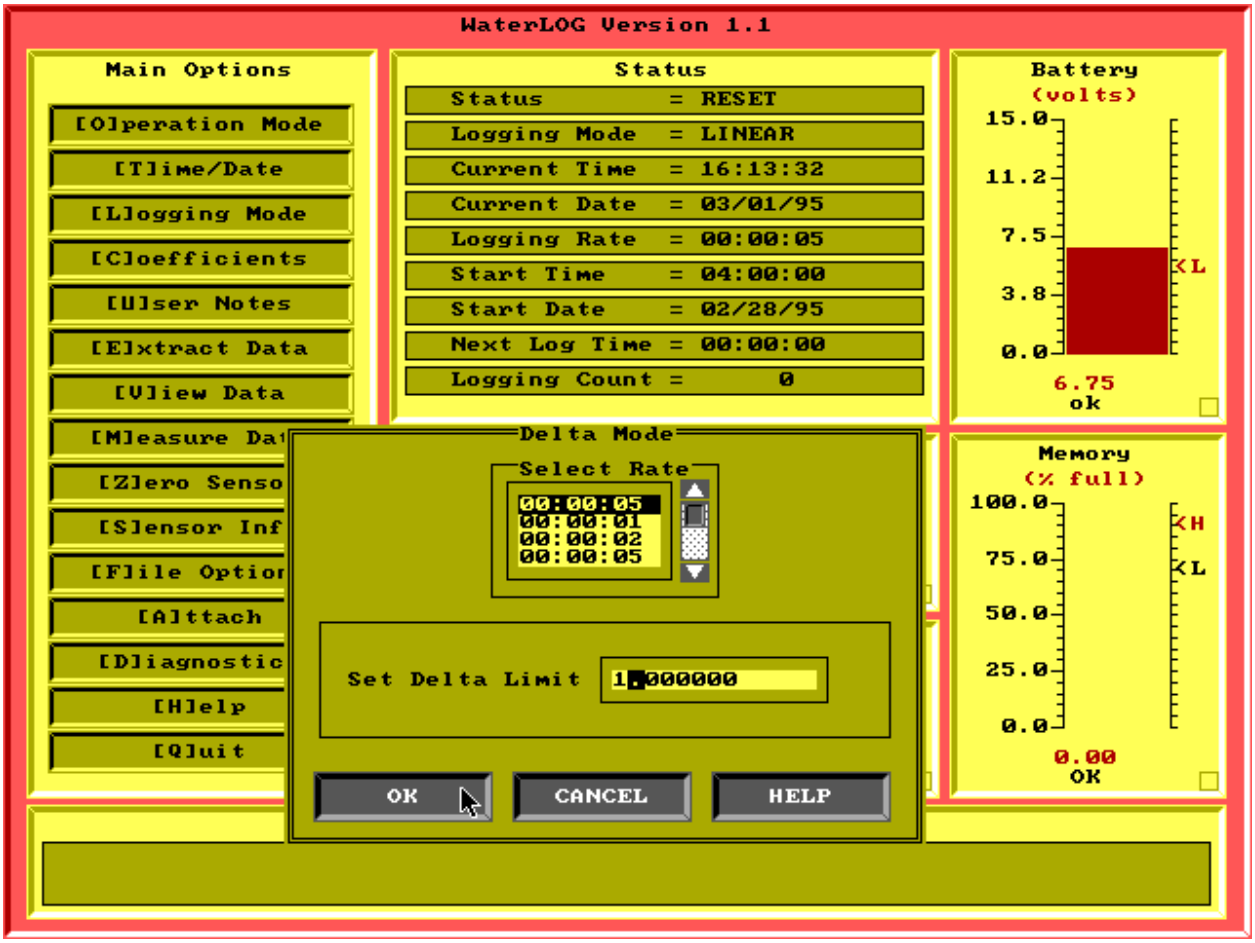

Figure 4-10. Delta Mode Option

4.4.3.3 Hyper Logging Mode Option

The Hyper Logging Mode shown in Figure 4-11 is used to log data at a regular time interval, like the linear mode, but if the rate of change of the level reading is greater than a set rate, the logging rate can be increased to a faster logging rate. In this mode all scanned data will be saved.

Logging Rate:

This is just like in the Linear Mode.

Hyper Limit:

The Hyper Limit will be expressed in the unit of measure specified under the conversion options with inches, feet, meters, PSI, etc., being common units for this field. As long as the difference between the current scanned level and the last logged level is less than this set hyper limit, the scan rate will stay at the regular rate. If the difference is greater than the set hyper limit, the scan rate will jump to a faster preset scan rate.

Hyper Divisor:

The Hyper Divisor is used to determine the faster scan rate. The faster scan rate is calculated by taking the regular scan rate and dividing it by the hyper divisor. The hyper divisor must be able to be divided into the regular scan rate without a remainder or it will default to 1. For example, if the regular scan rate is 1 minute, the following hyper divisors are valid:

SCAN RATE	HYPER DIVISOR	FAST SCAN RATE
1 minute	60	1 seconds
1 minute	30	2 seconds
1 minute	20	3 seconds
1 minute	15	4 seconds
1 minute	12	5 seconds
1 minute	10	6 seconds
1 minute	6	10 seconds
1 minute	5	12 seconds
1 minute	4	15 seconds
1 minute	3	20 seconds
1 minute	2	30 seconds
1 minute	1	60 seconds

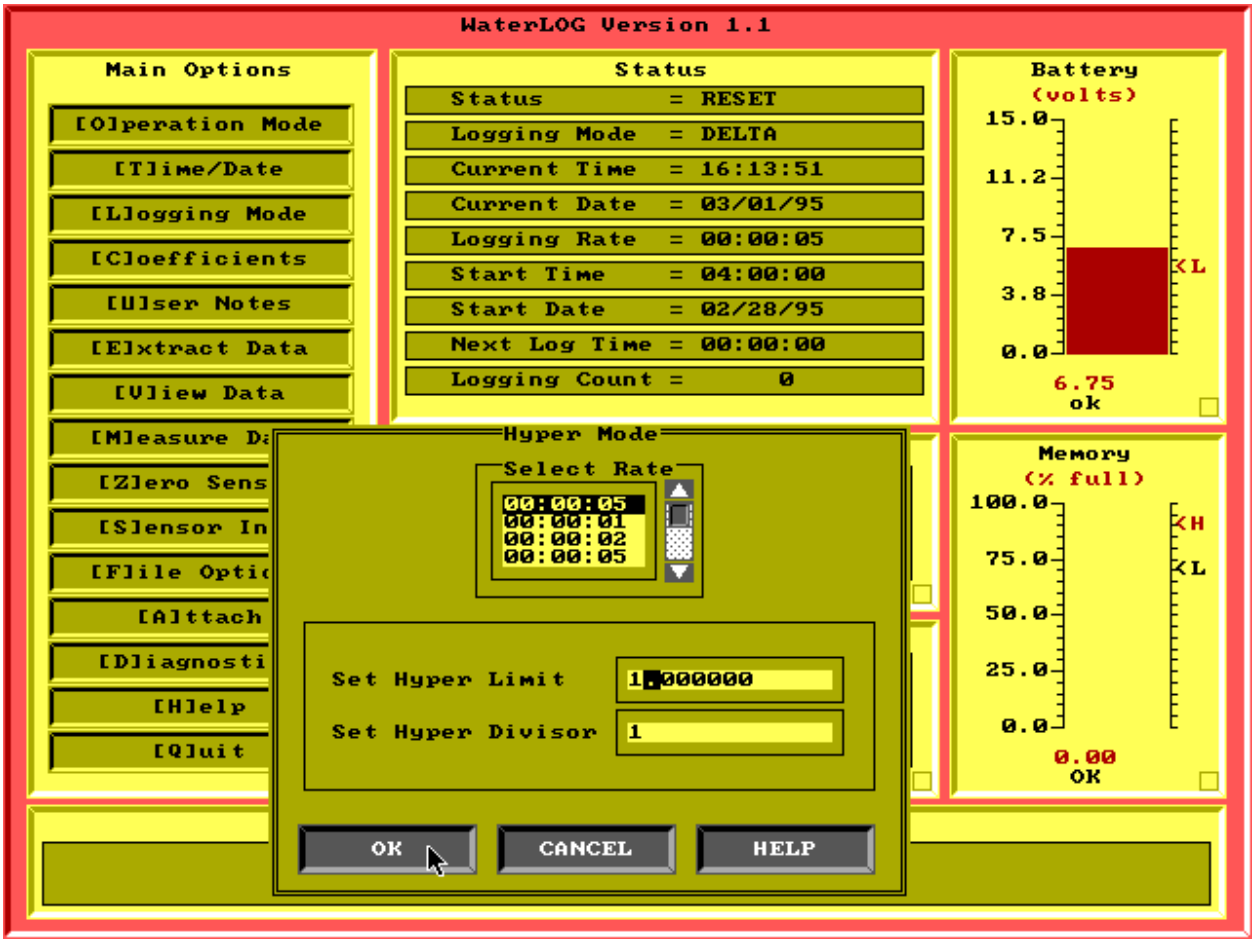

Figure 4-11. Hyper Mode Option

Here is an example of the Hyper Logging Mode.

The scan rate is set to 30 seconds, the hyper divisor is set to 15, and the hyper limit is set to 2.00 with the units assumed to be in feet. The logger is started and the first data point is logged. The next and all future logs will compute the difference between the current log and last log. If the difference is less than 2.00, the next log is scheduled to happen in 30 seconds. If the difference is greater than 2.00, then the next log is scheduled to happen in 2 seconds. (30 seconds/hyper divisor = 2). The sensor will stay on the 2-second interval until the next 30-second interval, at which time the sensor will evaluate the current log with the log 30 seconds previous to see if it should remain in the hyper mode or jump back to the normal mode.

This option allows the sensor to capture and record quick changing data without the expense of battery life by adjusting the scan rate based on the data change rate.

It is important to realize that the faster scan rate will not start until the sensor sees the change, so some of the changing data at the first may be lost. Determine what losses are acceptable, and what reporting times are needed to set up this mode of operation.

Again, note that this check is on the level parameter only, not the temperature, and the value entered will be in the same units as set in the coefficients options. For example, if the coefficients units are set to feet, the hyper limit will also be in feet.

4.4.3.4 Hyper-Delta Logging Mode Option

The Hyper-Delta Mode shown in Figure 4-12 is a combination of both the Hyper Mode and the Delta Mode.

Logging Rate:

This is just like in the Linear Mode.

Delta Limit:

The Delta Limit sets the point that determines if the scanned data is to be logged or not. Each time the sensor takes a reading, it will compute the absolute difference between this reading and the last logged reading. If the difference between the new value and the last logged value is less than the delta limit, the sensor will not log the new data. If the difference between the scanned value and the last logged data is greater than the delta limit, the new data will be logged.

Hyper Limit:

The Hyper Limit will be expressed in the units of measure specified under the conversion options with inches, feet, meters, PSI, etc., being common units for this field. As long as the difference between the current scanned level and the last logged level is less than this set hyper limit, the scan rate will stay at the regular rate. If the difference is greater than the set hyper limit, the scan rate will jump to a faster preset scan rate.

Hyper Divisor:

The Hyper Divisor is used to determine the faster scan rate. The faster scan rate is calculated by taking the regular scan rate and dividing it by the hyper divisor. The hyper divisor must be able to be divided into the regular scan rate without a remainder or it will default to 1. For example, if the regular scan rate is 1 minute, the following hyper divisors are valid:

SCAN RATE	HYPER DIVISOR	FAST SCAN RATE
1 minute	60	1 seconds
1 minute	30	2 seconds
1 minute	20	3 seconds
1 minute	15	4 seconds
1 minute	12	5 seconds
1 minute	10	6 seconds
1 minute	6	10 seconds
1 minute	5	12 seconds
1 minute	4	15 seconds
1 minute	3	20 seconds
1 minute	2	30 seconds
1 minute	1	60 seconds

This option allows the sensor to capture and record quick changing data without the expense of battery life by adjusting the scan rate based on the data change rate. It also saves memory by not logging data when the data is not changing significantly.

Note that this check is on the level parameter only, not the temperature, and the values entered for the hyper limit and delta limit will be in the same units as set in the coefficients options. For example, if the coefficients Pressure / Level option is set to feet, the hyper limit and delta limit will also be in feet.

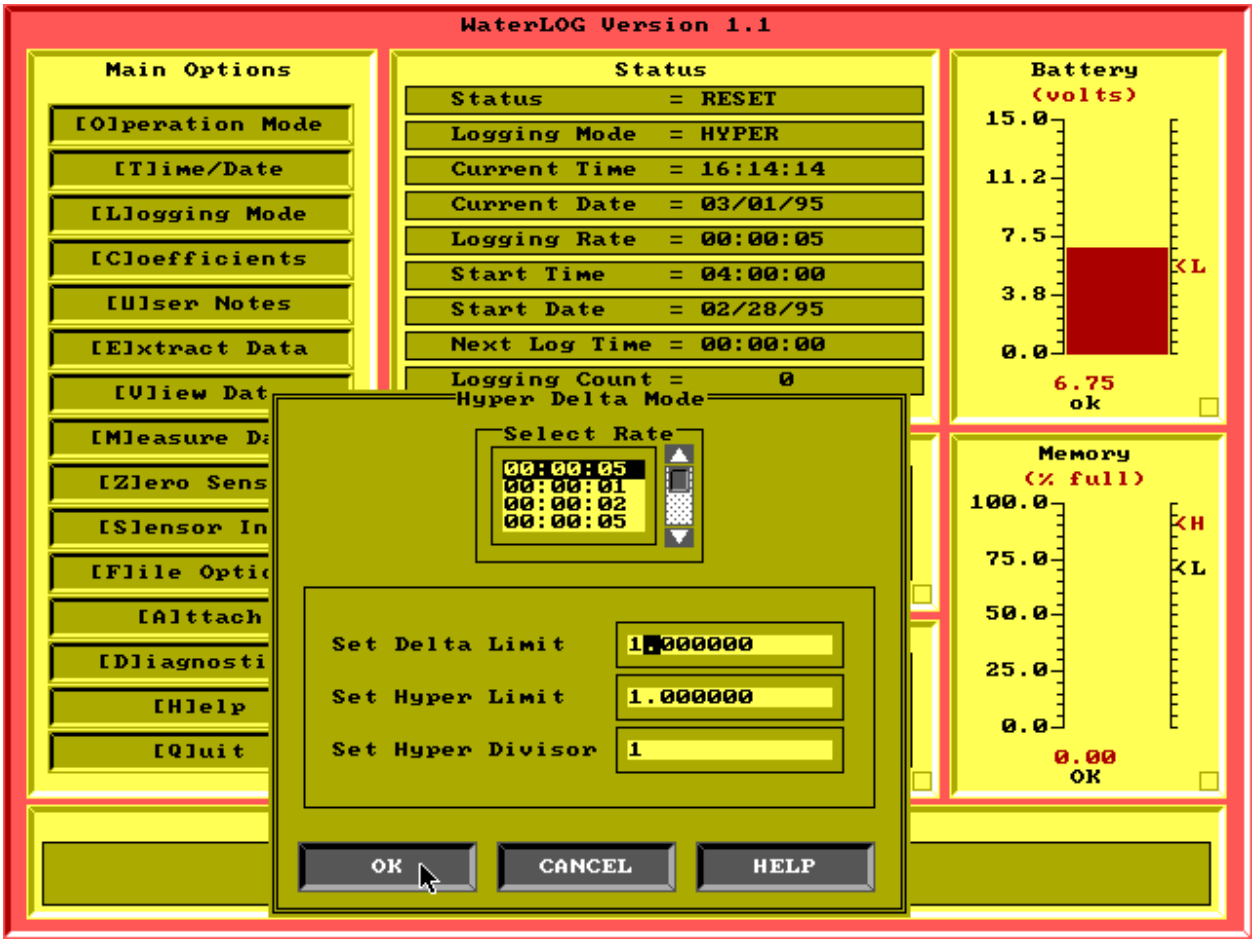

Figure 4-12. Hyper-Delta Mode Option

4.4.3.5 Variable Logging Mode Option

The Variable Logging Mode shown in Figure 4-13 is used to set up special logging modes like a simulated logarithmic logging rate used in pump or slug tests on a well. There are six different time periods in this mode and each can be set for a different logging rate and length.

Select Rate X:

The top half of the screen has six boxes labeled “Select Rate 1” to “Select Rate 6”. Each box represents a time period and allows the logging rate for that time period to vary independently from the other time periods.

The top item in each box is the current logging rate for the specified time period.

Number of Samples:

The bottom half of the screen has 5 boxes labeled “Time 1” to “Time 5”. This represents the time periods 1 to 5. The number in each box is the number of scans that will be done during that time period. There are six time periods, but only options to set the number of scans for the first five. This is because the last time period will log data at the specified rate until you stop the logging process. Setting the number of scans to zero for a time period will cause that time period to be skipped.

As mentioned, this mode is used to simulate a logarithmic logging mode. Below is a simple setup showing a logarithmic type logging setup.

	Time between samples (Rate)	Number of samples (Samples)	Time Interval
Logging Rate 1	00:00:02	59	0 - 2 min.
Logging Rate 2	00:00:15	32	2 min. - 10 min.
Logging Rate 3	00:02:00	25	10 min. - 1 hr.
Logging Rate 4	00:15:00	28	1 hr. - 8 hrs.
Logging Rate 5	02:00:00	32	8 hrs. - 72 hrs.
Logging Rate 6	12:00:00	On going	72 hrs. -

This example shows the logging rate starting out fast and then slowing down. The rate can be change as needed; slow to fast, fast to slow, and back to fast. etc.

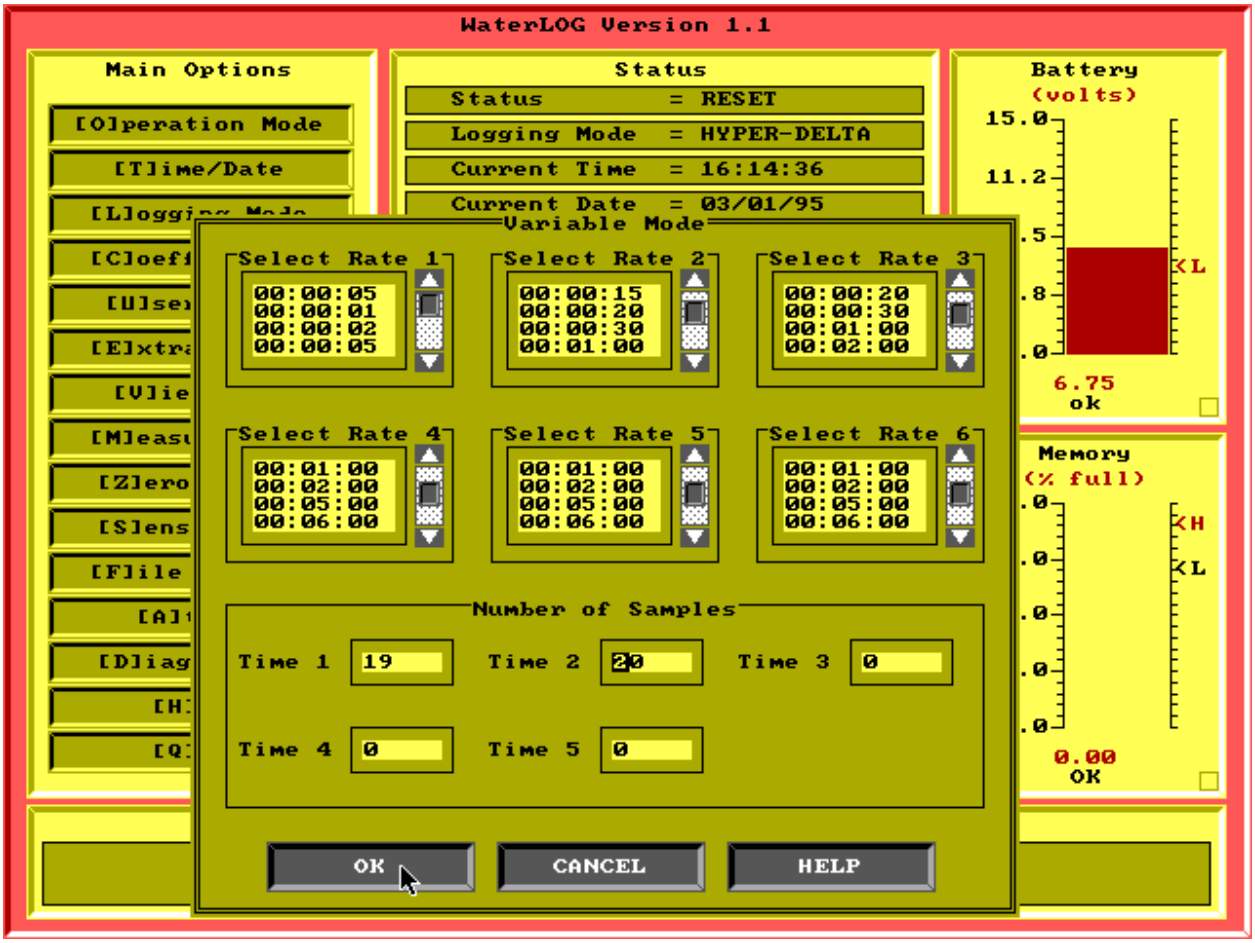

Figure 4-13. Variable Logging Mode Option

4.4.4 Coefficients Option

The Coefficients options shown in Figure 4-14 are used to set the desired units of measure for the level and the temperature. If one of the predefined options is not usable, you can enter in your own equation as needed.

Pressure / Level:

The standard choices for pressure / level are inches, feet, centimeters, meters, and PSI. When one of these choices is used, the conversion factors are automatically setup as needed. If none of the standard choices will do for the level measurement, the "User Defined" option can be used to allow you to convert the level to any desired units.

Temperature:

The standard choices are Celsius and Fahrenheit. Again, if one of the standard choices is used, the conversion factors are setup automatically. If the standard choices are not usable, the "User Defined" option can be used to enter in a more appropriate conversion.

Pressure Compensation:

The options here are "User Defined" and "Default". In most cases, selecting "Default" will provide sufficient accuracy, however, the accuracy may be increased by selecting the "User defined" and entering in the requested information.

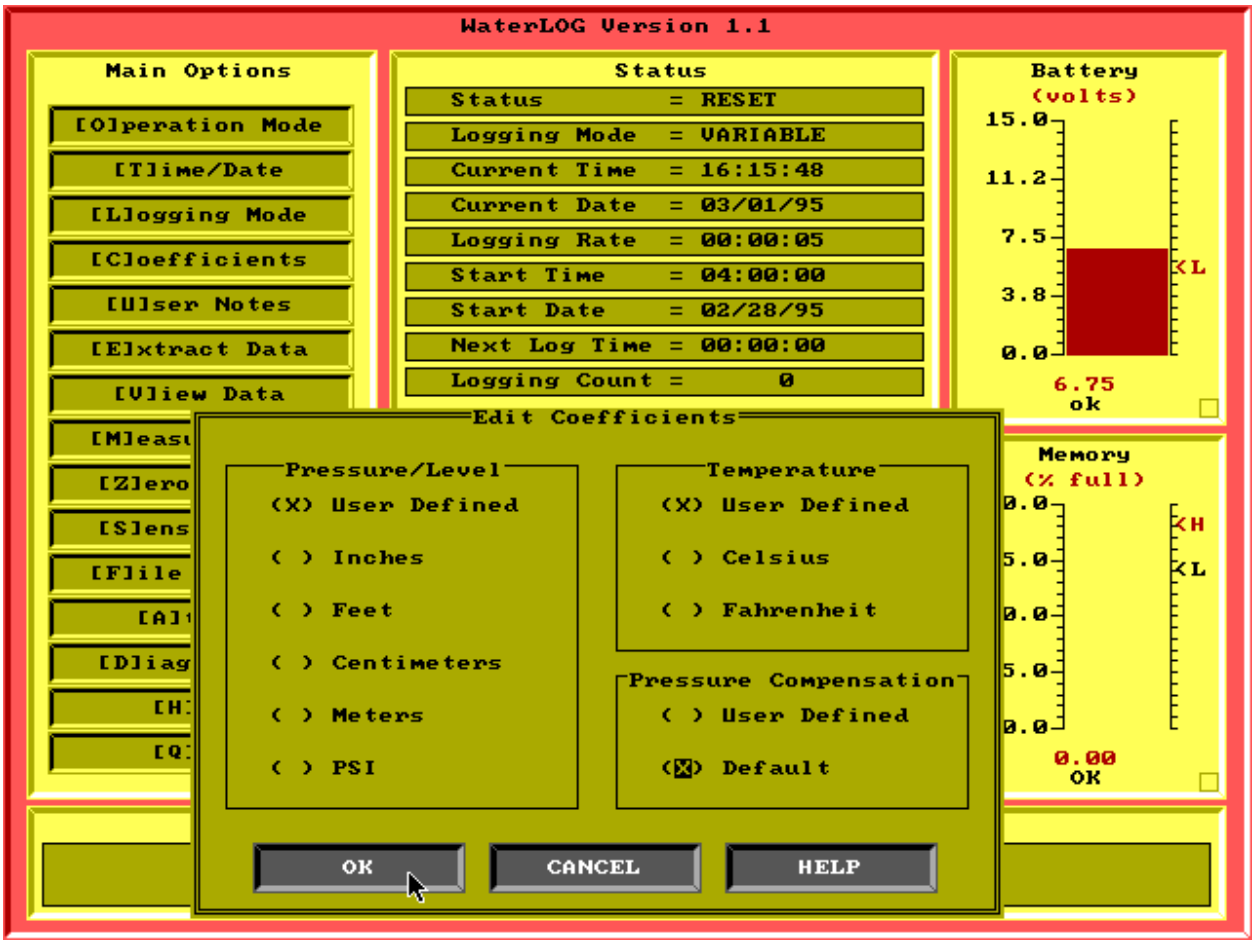

Figure 4-14. User Coefficients and User Units Option

Note: It is important to program these values correctly. The data displayed in the last measurement window will reflect the scaled value. The "***WATER*LOG**" performs scaling math to the measurement before it is stored into FLASH EEPROM. Also, the extracted data from the "***WATER*LOG**" sensor will reflect the scaled value.

4.4.4.1 Pressure Coefficients Option

The User Defined Pressure Coefficients Option shown in Figure 4-15 allows you to modify the level or pressure coefficients and the units label. The equation for the temperature conversion has the following form.

Units = (X) * (Slope) + (Offset)

Units: The user preferred unit of measure. Examples are feet, meters, inches, PSI or whatever you prefer.

X: This is the default value returned from the sensor in PSI.

Slope: This is the M factor of the standard Y = MX + B equation. It represents a rate of change for a given change of X.

Offset: This is the B factor of the standard Y = MX + B equation.

The offset can also have a value added to it to allow the results to be referenced to some other point like sea level.

When entering this option, the values will reflect the last valid setting used for pressure. For example, if the predefined "Feet" option was the last valid selection, then under "User Defined" the units would be "Feet", the Offset would be 0.0 and +2.308613 would be the slope. The conversion from PSI to feet is: FEET = PSI * 2.308613 + 0.0, using a latitude of 40°, an elevation of 1000 Meters above sea level, and a media density of 999.972 Kg/M^3.

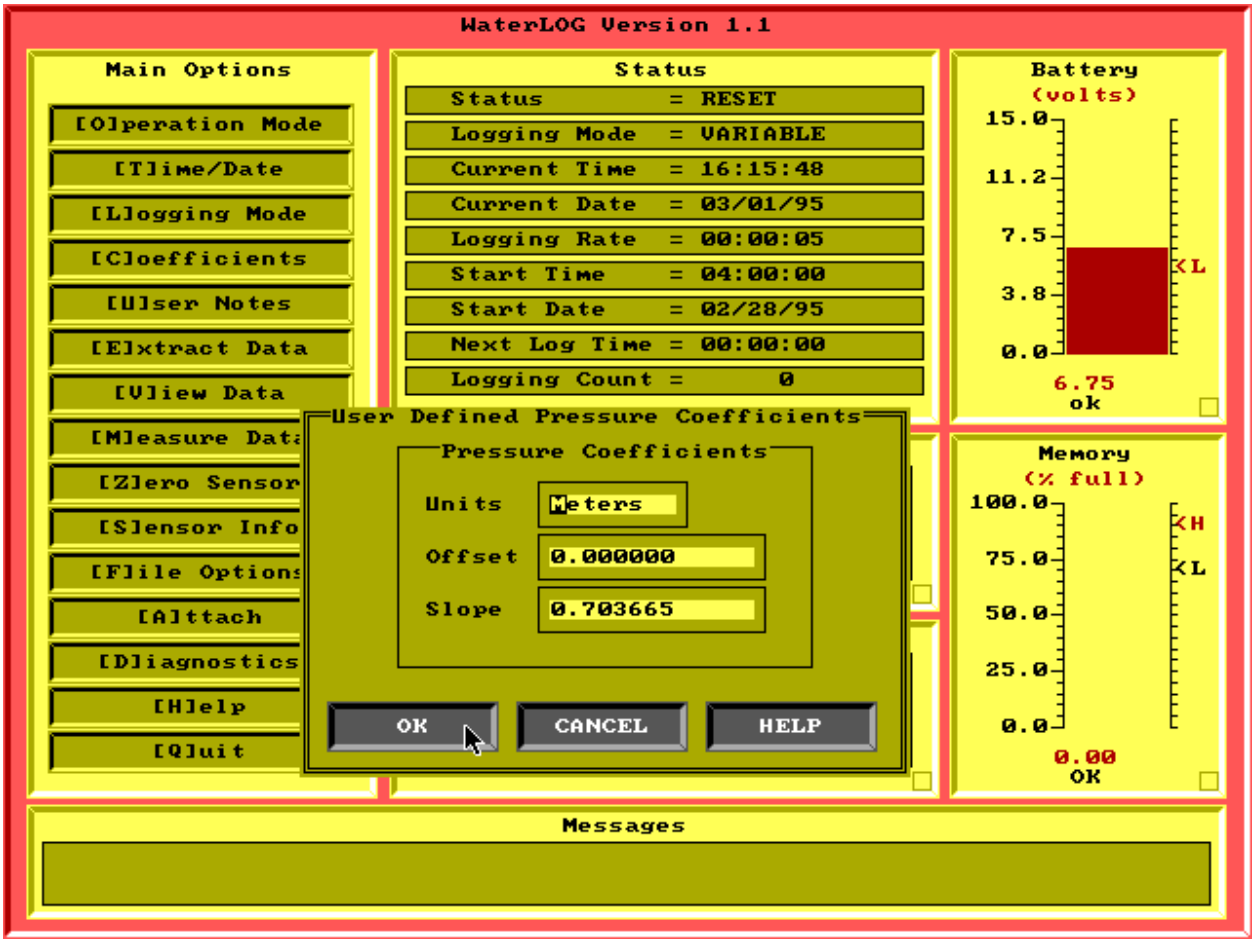

Figure 4-15. User Defined Pressure Coefficients Option

4.4.4.2 Temperature Coefficients Option

The User Defined Temperature Coefficient Option shown in Figure 4-16 allows you to modify the temperature coefficients and the units label.

The equation for the temperature conversion has the following form.

Units = (X) * (Slope) + (Offset)

Units:

The user preferred unit of measure. The normal units are Fahrenheit, Celsius, Kelvin, and Rankine.

X:

This is the default value returned from the sensor and has already been converted to degrees C.

Slope:

This is the M factor of the standard Y = MX + B equation. It represents the rate of change for a given change of X.

Offset:

This is the B factor of the standard Y = MX + B equation.

The offset can also have a value added to it to allow the results to be referenced to some other point like freezing or boiling point.

When entering this option, the values will reflect the last valid setting used. For example, if Celsius was the last valid selection, the units would be “Deg C”, the slope would be “1.0” and the offset would be “0.0”. These values are straight forward because the sensor returns temperature in degrees C. If Fahrenheit was selected, the units would be “Deg F”, the slope would be “1.80” and the offset would be “32”.

To convert to Kelvin use +273.15 for the offset and +1.0 for the slope. Kelvin is equal to 273.15 + degrees C.

To convert to Rankine use +491.67 for the offset and +1.8 for the slope. Rankine is 459.67 + degrees F.

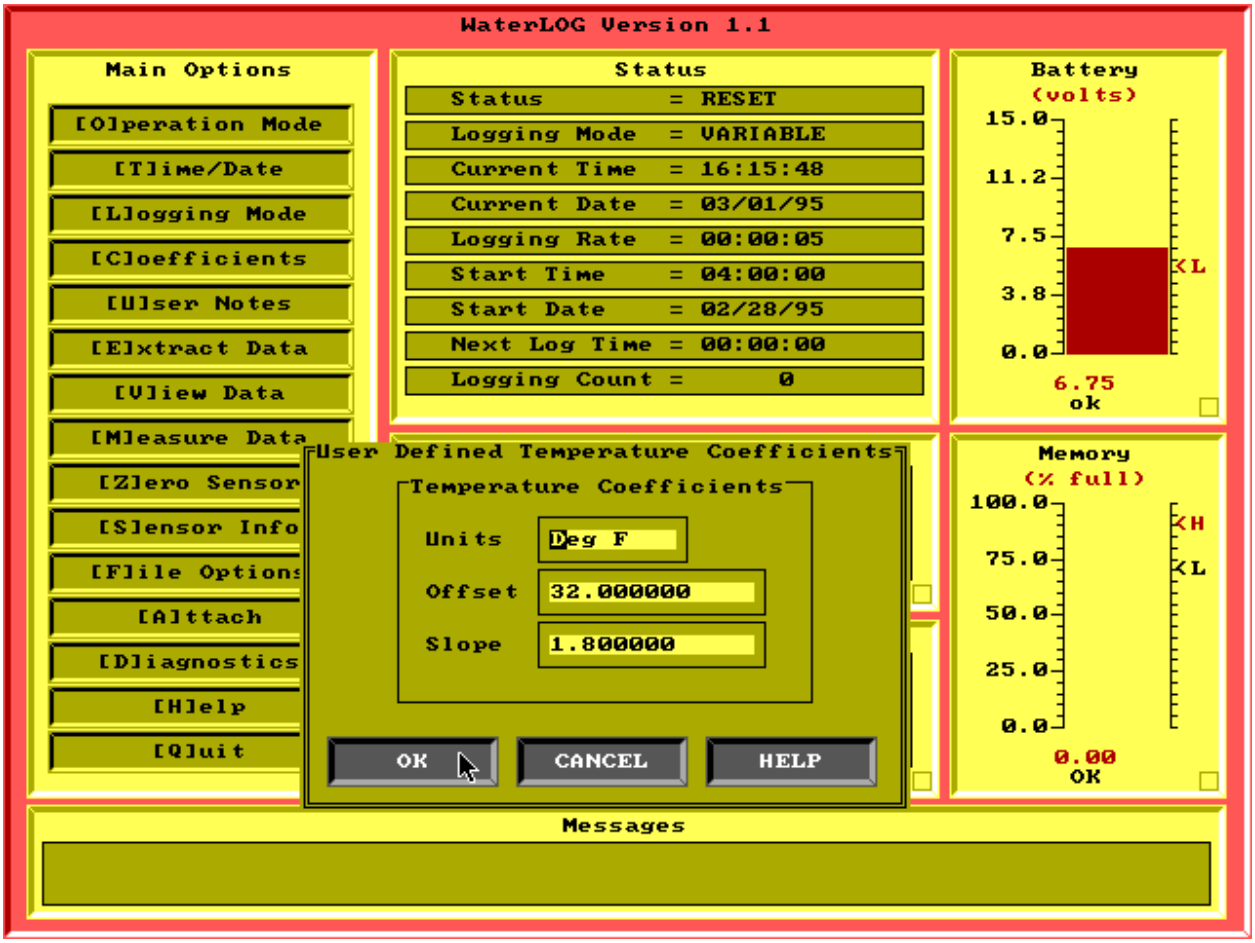

Figure 4-16. User Defined Temperature Coefficients Option

4.4.4.3 Pressure Compensation Option

The User Defined Pressure Compensation Options shown in Figure 4-17 are provided so you can guarantee the accuracy of the data for your application. Level readings will vary based on latitude, elevation, and density of the medium to be measured.

Latitude:

The first option is to enter in the latitude of the site. This must be in the range of 0 to 90 degrees. The default is 0 degrees. The difference in force from 0 degrees to 90 degrees is 0.1699 ft/sec^2.

Elevation:

The second option is to enter the elevation above sea level in meters. The default is 0 meters. Gravity will decrease at a rate of about 0.003085 ft/sec^2/1000 ft.

Density:

The third option is to enter the density of the liquid to be measured.

Offset:

The fourth option is to enter any desired offset. This may be used to add an offset to make the level reading reference some point like sea level, or for example, the top of a dam. If the User Defined Pressure Option is used, the additional offset will have to be added there.

This option will not be available when PSI or user defined modes are selected under the pressure option.

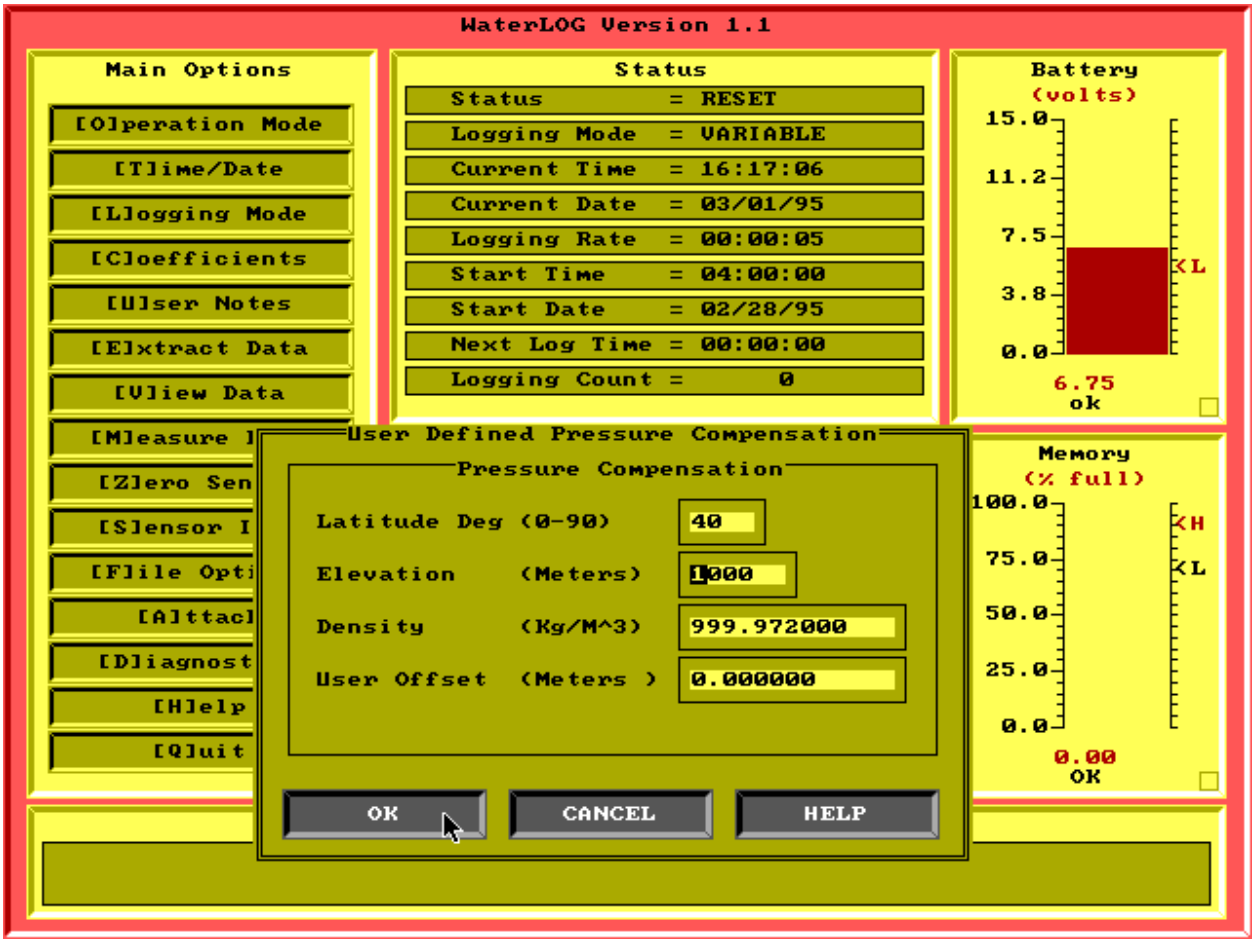

Figure 4-17. User Defined Pressure Compensation Option

4.4.5 User Notes Option

The "***WATER*LOG**" stores 160 characters of User Notes in the FLASH EEPROM. These notes allow you to enter information which will be recovered during data extraction. Figure 4-18 shows a sample User Notes screen. User Notes have been broken up into four independent lines of 40 characters each. There is no wrapping feature between lines, therefore, each line needs to be edited independently. If the INSERT key is pressed, you can insert characters until the maximum length of 40 characters is reached.

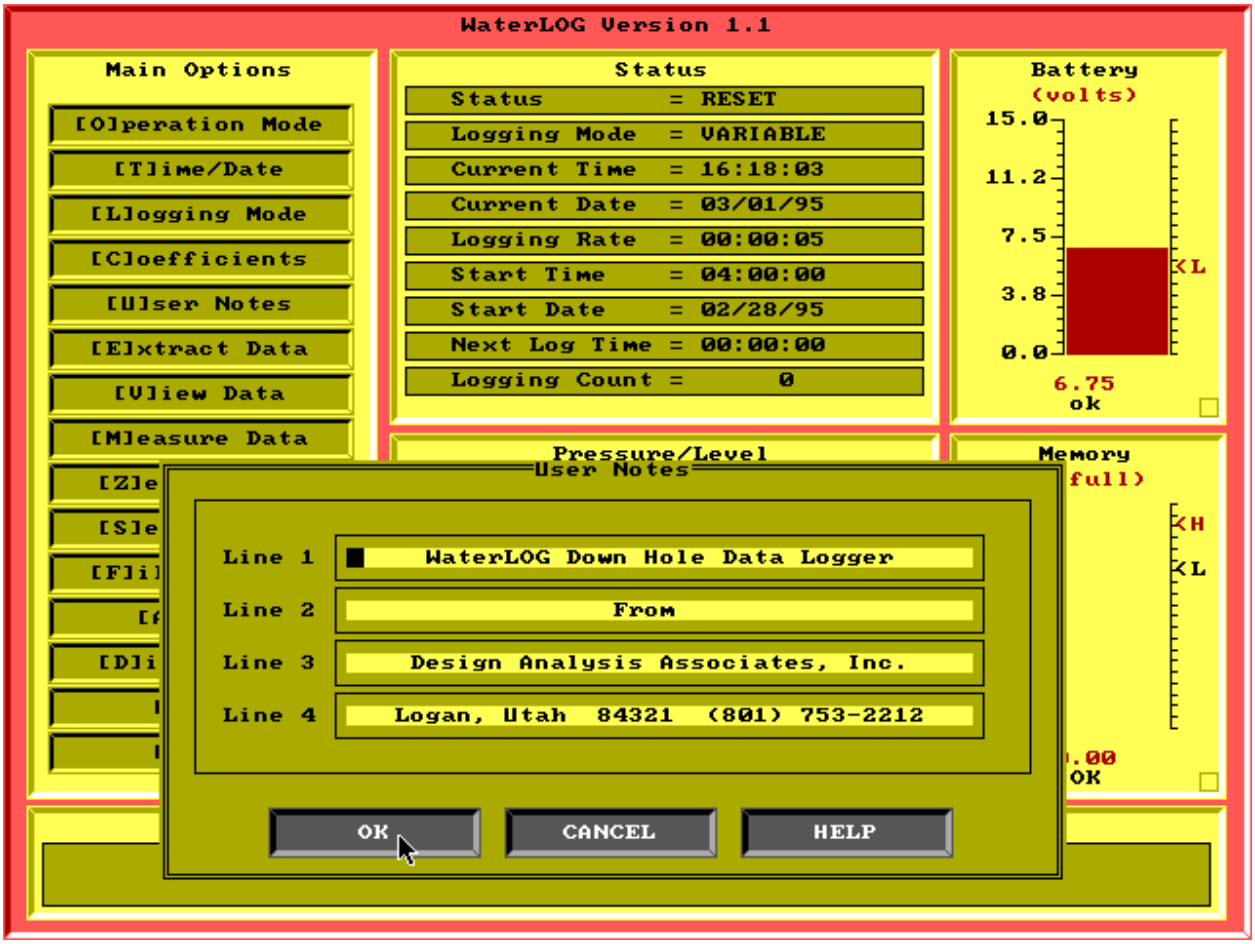

Figure 4-18. User Notes Option

The User Notes can be used to store information while the sensor is logging. This is useful for entering site conditions, for example: "Jan 1, 95 Replaced Battery".

4.4.6 Extract Data Option

You can extract data that is stored in the FLASH EEPROM shown in Figure 4-19. You can select to transfer all the data stored in the "***WATER*LOG**" or transfer only the last xxx scans in memory (where xxx is a number between 1 and the total number of scans available) or transfer only the new data stored from the previous download.

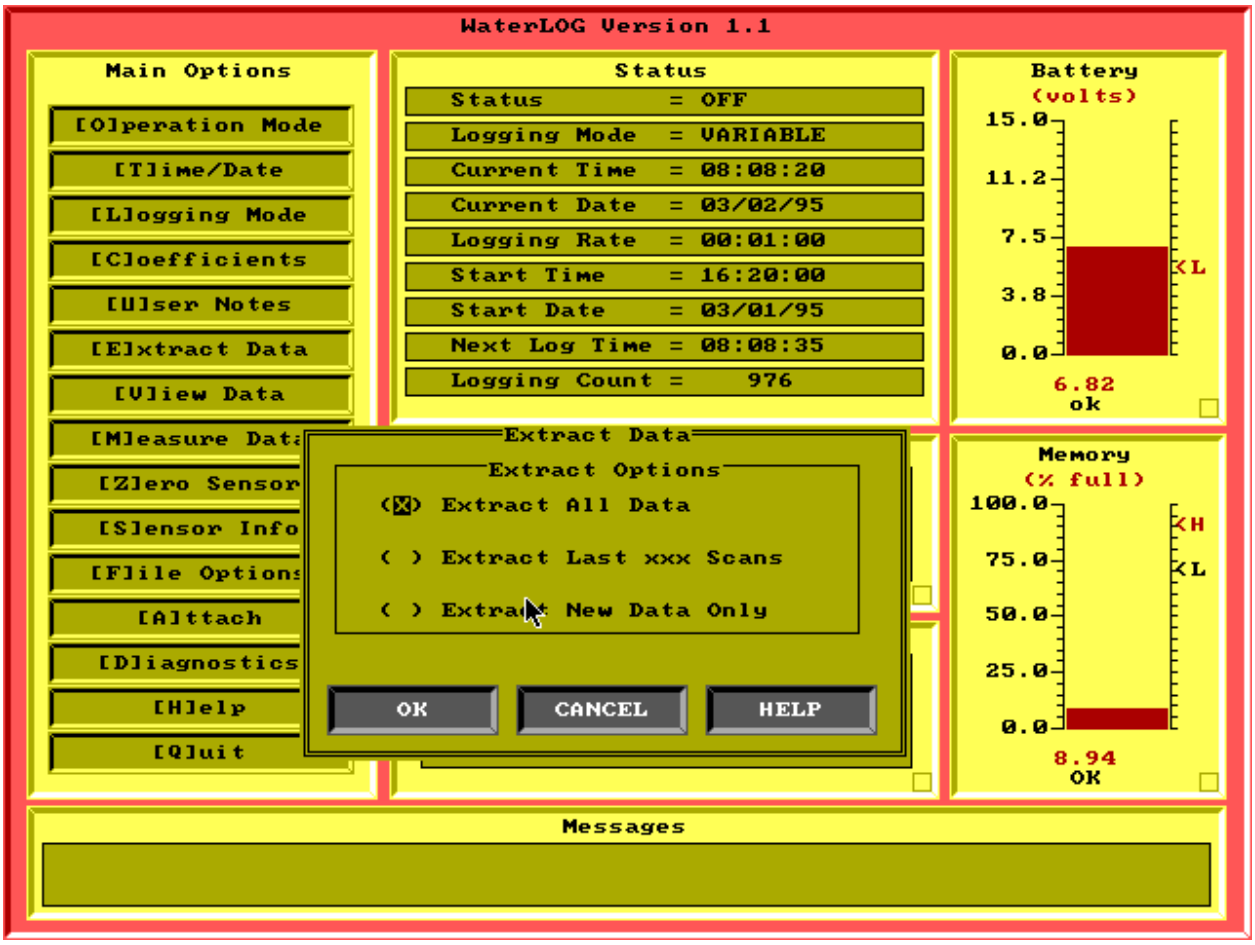

Figure 4-19. Extract Data Option

Shown in Figure 4-20, the software running in the computer will cause the "***WATER*LOG**" to transfer the data to the computer and place the data in a user specified file. Below are the options available to you for saving files.

New Filename:

You can type in a new file name leaving the extension as it was, or overwrite an existing file by highlighting the file in the second box down, the file list box.

File List Box:

The second box down is the file list box and will show all the files that match the mask, all sub directories, and the parent directory. Any file or directory may be highlighted by placing the mouse on it and pressing the left mouse button. When changing from one directory to another, highlight the directory and press the ENTER key. The screen will be updated with the information in the new directory. Using the mouse and selecting the OK button will not work when changing directories.

DIR:

The third box down is a status box showing the current path and directory. This box cannot be edited.

Drive:

The fourth box down is the current drive and this can be edited by changing the drive letter and using the ENTER key. Using the mouse to select the OK button will not work when changing the drive.

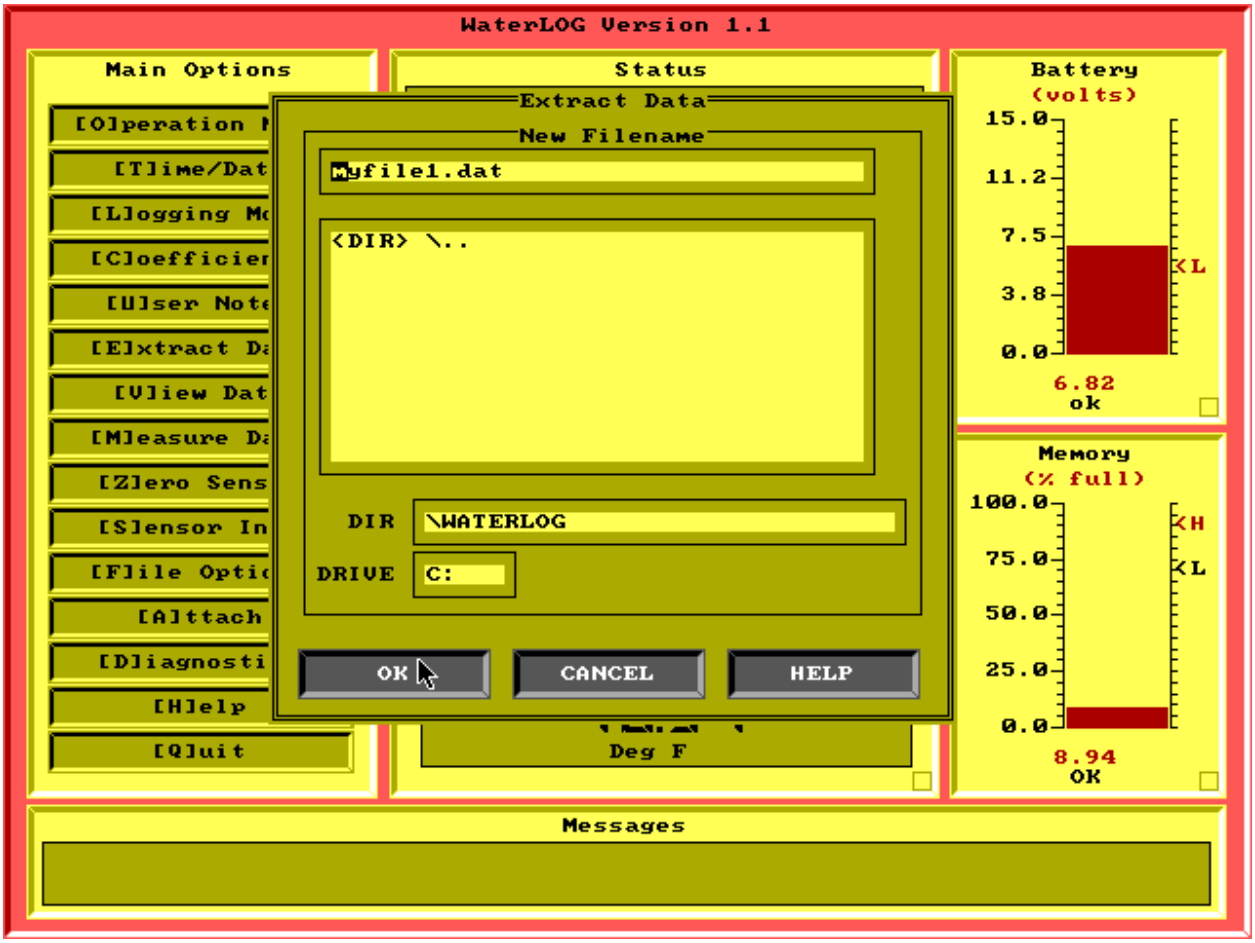

Figure 4-20. Filename Input

Figure 4-21 shows a sample screen which is displayed during the Extract All Data process. This process can take several minutes when the FLASH EEPROM is full of data. The format of this file is described in chapter 5 “Guide to Data Analysis”. You can see the percentage of completion as shown on the screen.

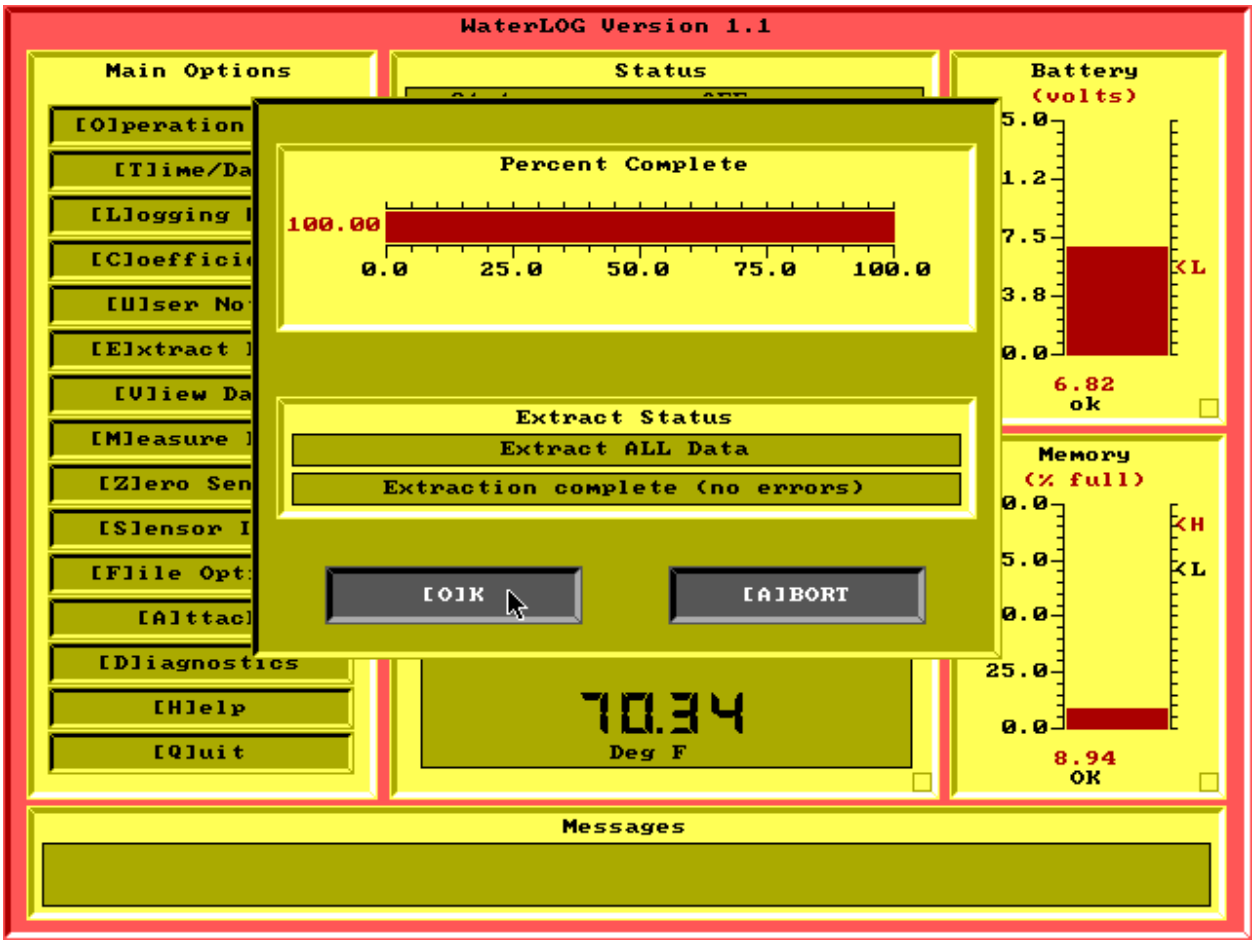

Figure 4-21. Extract ALL Data Option

The “Last XXX Scans” option shown in Figure 4-22 allows you to retrieve a portion of the data file starting with the most current data. This is helpful if you are only interested in seeing the last few data points and do not want to take the time to extract the entire data file.

Total Scans:

When this option is first entered, the total number of scans is displayed in the top box. This box is a status box only and cannot be edited.

Number of Scans to Retrieve:

The second box defaults to the total number of scans, but may be changed to any number between 0 and the total number of scans. If a number larger than the total scans is entered, the "***WATER*LOG**" software will adjust the number to the total number of scans and start the extract process.

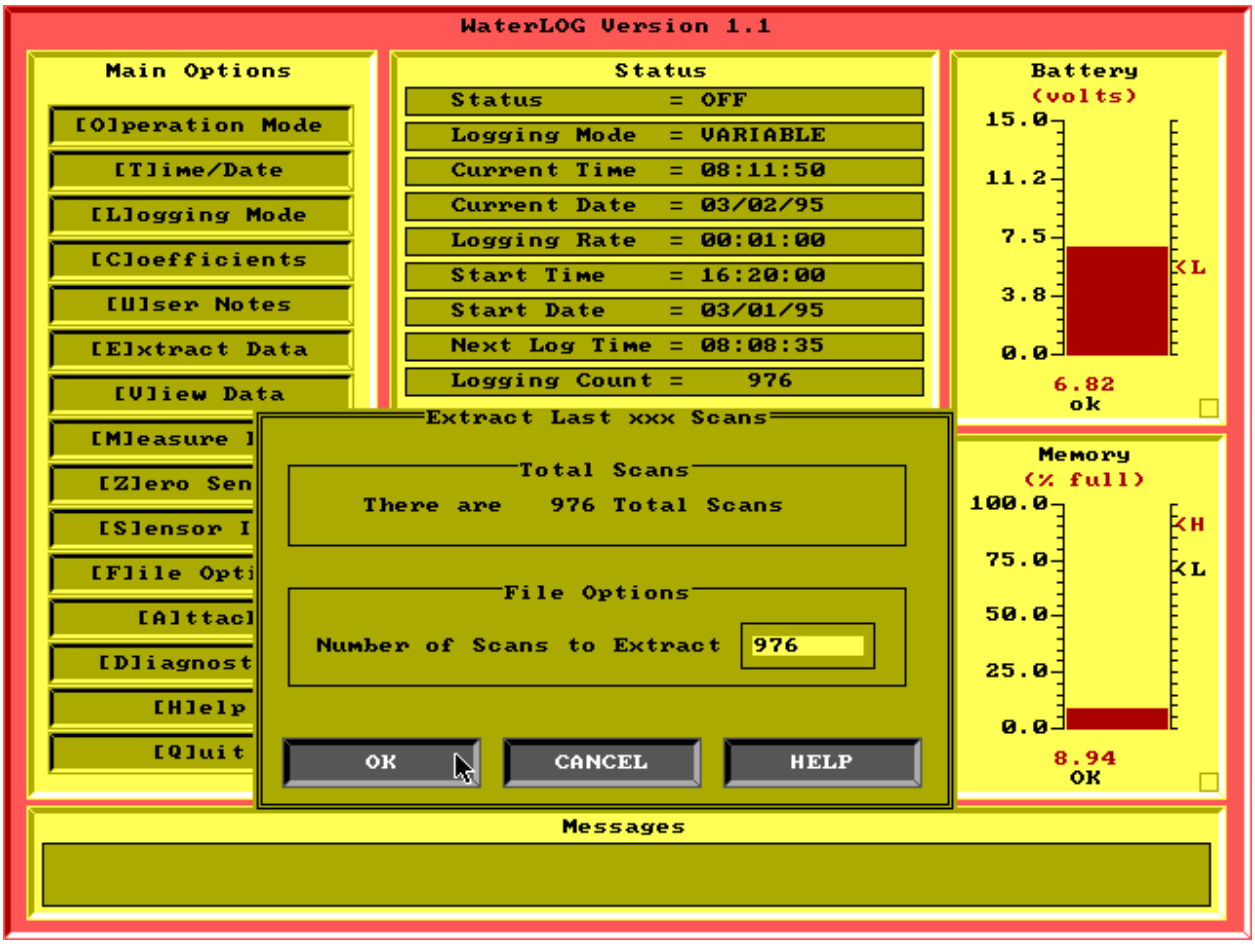

Figure 4-22. Extract Last XXX Scans

Figure 4-23 shows a sample screen which is displayed during the Extract New Data process. This option extracts all data recorded since the last time data was extracted. You can see the percentage of completion as shown on the screen.

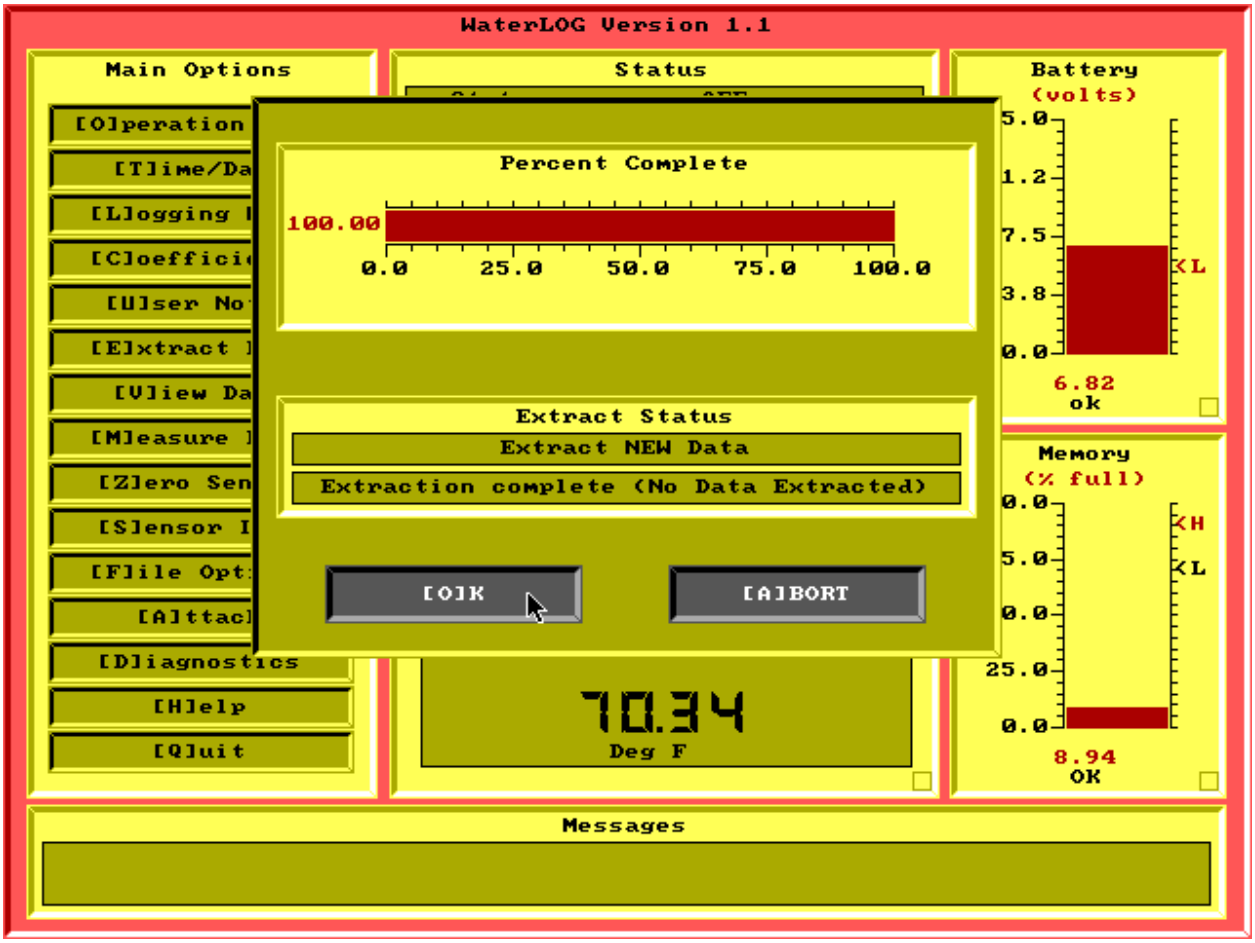

Figure 4-23. Extract NEW Data Option

Warning: If the power has failed in the "***WATER*LOG**", the FLASH EEPROM will still contain the data sampled up to the time of the power failure. Power to the "***WATER*LOG**" must be restored. Memory pointers will be initialized to the last location in the FLASH EEPROM. Therefore, extract data before resetting the "***WATER*LOG**".

4.4.7 View Data Option

The "View Data" options shown in Figure 4-24 allow an easy way to view the data in either a tabular form or as a graph.

View Options:

The "View Options" portion of this screen is used to select the method to use to view the data. The choices are tabular or graphical.

Selecting tabular will display the data in a tabular report format. You can scroll through the data.

Selecting graphical will display the data in a graphical format allowing you to customize and print the graph.

Source Options:

The source of the data can be from the sensor or from a data file that was retrieved from the sensor at an earlier time.

If viewing data from the sensor in a graphical mode while the sensor is still logging, note that only the data that was stored in memory at the time the view option was entered will be displayed. Data logged after the view option was entered will still be logged but will not be visible during this viewing session. In other words, you cannot view the data in real time.

While viewing data from the sensor in a tabular mode with the sensor still logging, note that if the data in memory has wrapped, the viewed data may be changing as you move through the data. In tabular mode, the screen is updated in real time.

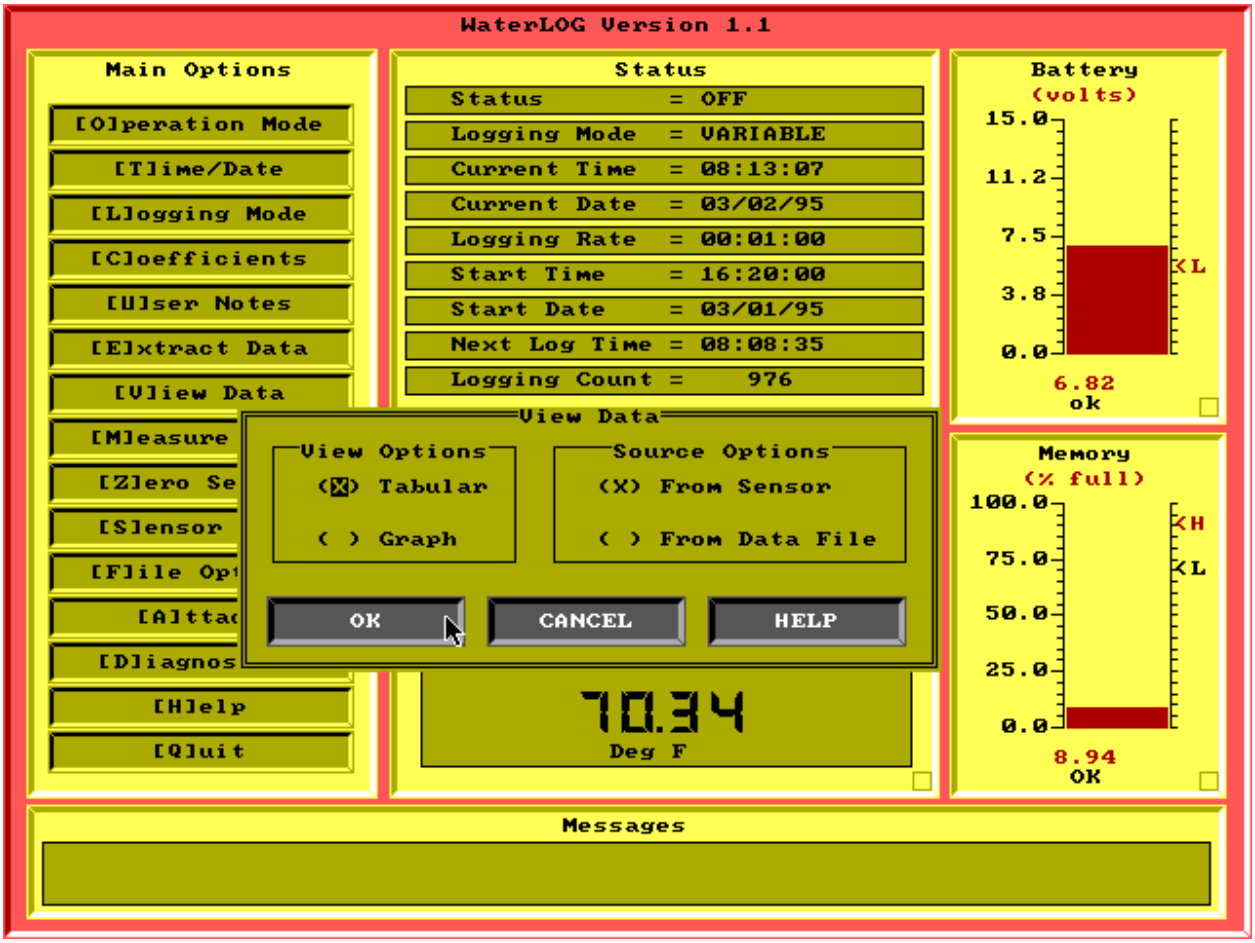

Figure 4-24. View Data Option

You can examine the data stored in the FLASH EEPROM or a data file, by selecting View Data Tabular. The display will show Scan Number, Date, Time, Pressure, Temperature, and Battery Voltage as shown in Figure 4-25. Up to 16 samples can be displayed on the screen. If more than 16 samples are stored in memory, the “Home”, “End”, “PgUp”, “PgDn”, “↑”, and “↓” keys can be used to move through the data. Clicking on the corresponding buttons will also accomplish the same thing. A Scan Number can also be entered to help you jump to a specific location in the data.

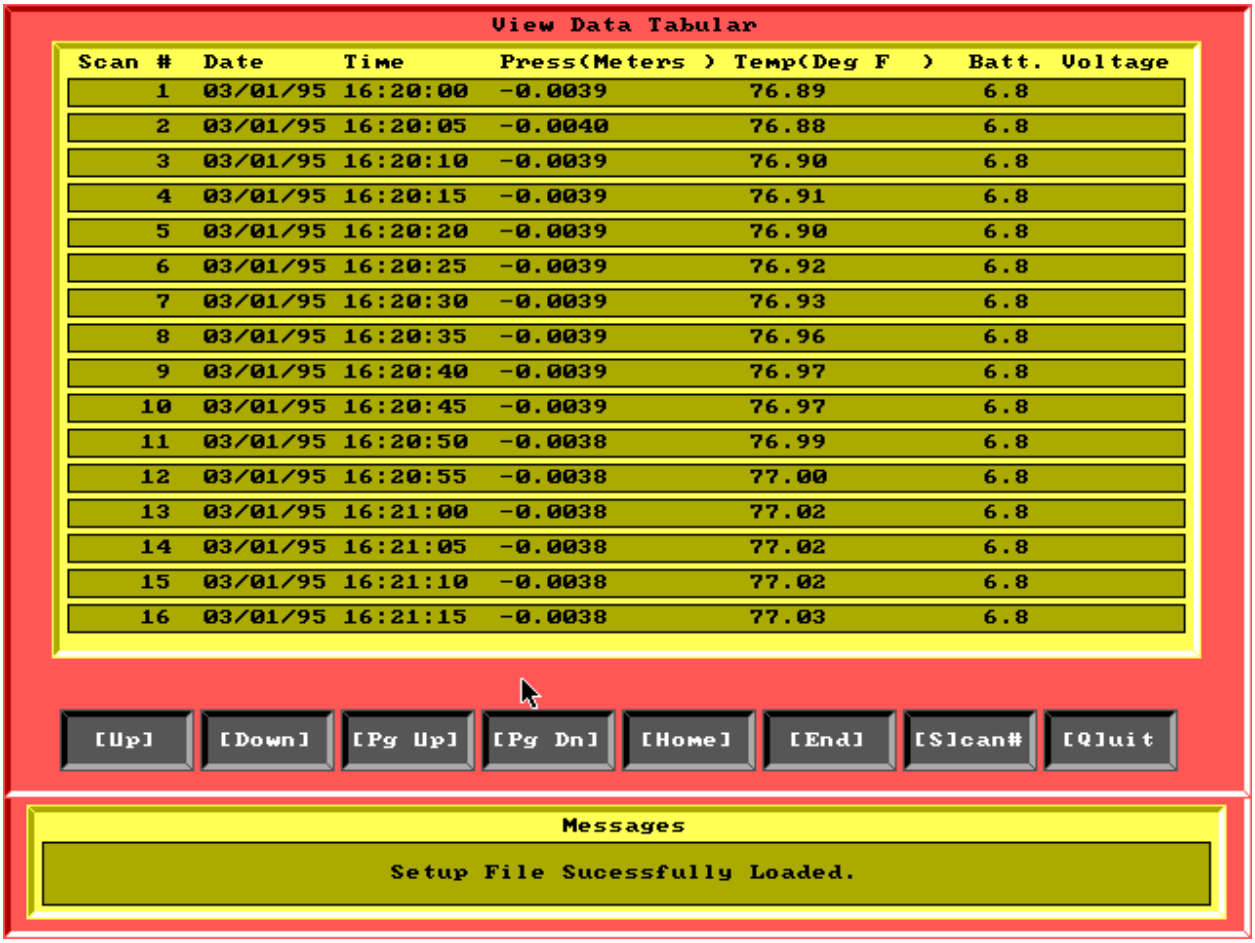

Figure 4-25. View Data Tabular Display

The View Scans Option From "***WATER*LOG**" shown in Figure 4-26 is used to select what data is to be viewed. The top box shows the total number of scans in the sensor. This is a status box only.

Beginning Scan Number to View:

The first option in the bottom box is used to set the beginning point for viewing data. The default is 1, indicating start at the beginning of the data. This can be any number up to the maximum number of scans available minus 1, and must be less than the ending scan number entered in the next option.

Ending Scan Number to View:

The last option in the bottom box is used to set the ending point for viewing data. The default is the maximum number of scans available. This can be any number greater than the beginning point up to the number of available scans.

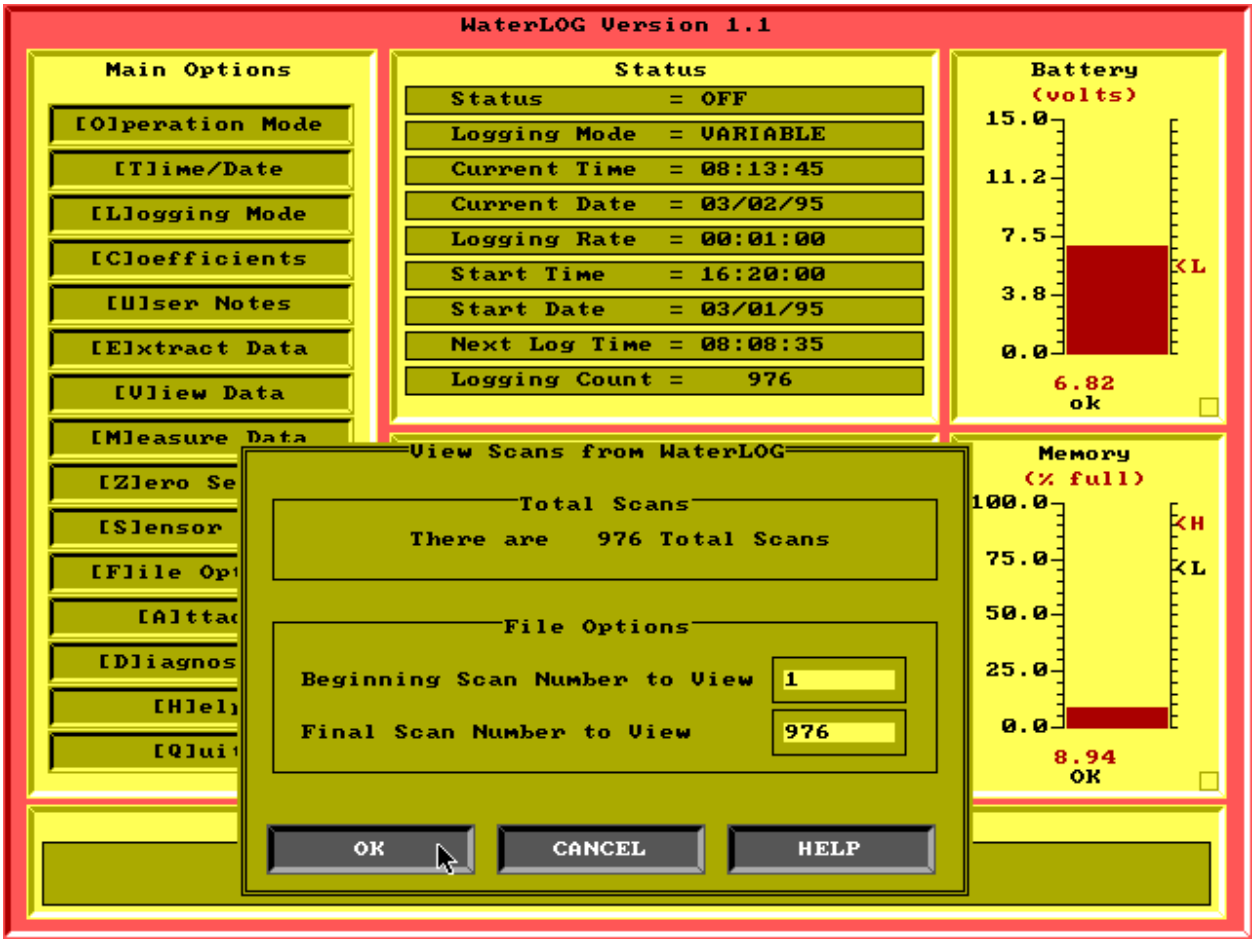

Figure 4-26. View Scans From ***WATERLOG*** Option

When first entering this screen, there will be one graph labeled “Main” (shown in Figure 4-27) which shows all the data to be graphed. Pressing the button “Both Graphs” (shown in Figure 4-28) will spilt the screen to show a second graph labeled “Auxiliary”. When both graphs are displayed, the master graph will also have two cursors (white vertical lines). The auxiliary graph will show all the data between the cursors. The cursors can be moved using the buttons on the bottom of the screen allowing the cursors to zoom in, zoom out, pan left, and pan right. While in the Both Graphs mode, the option button will provide even more features for the auxiliary graph.

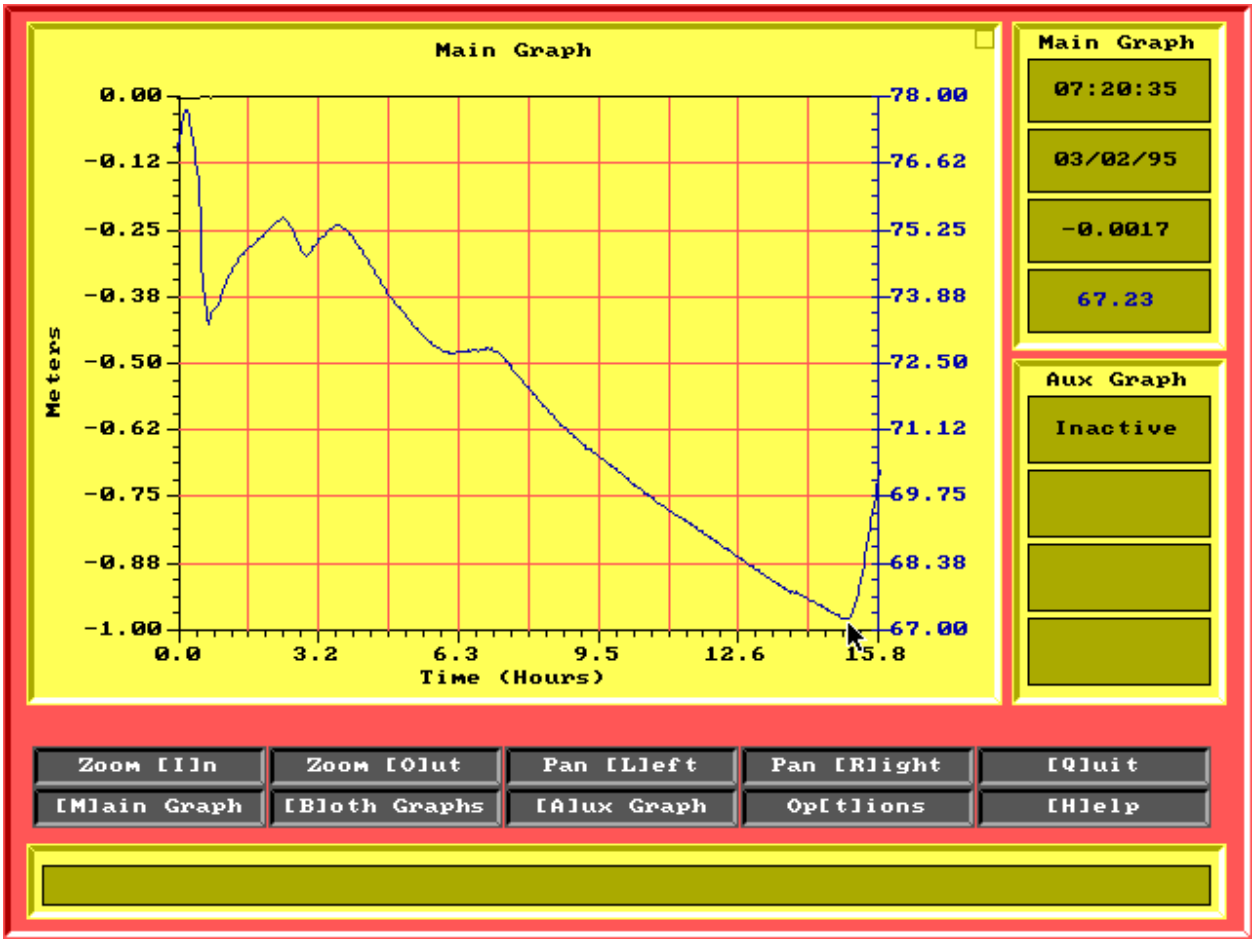

Figure 4-27. View Graphical Main Graph

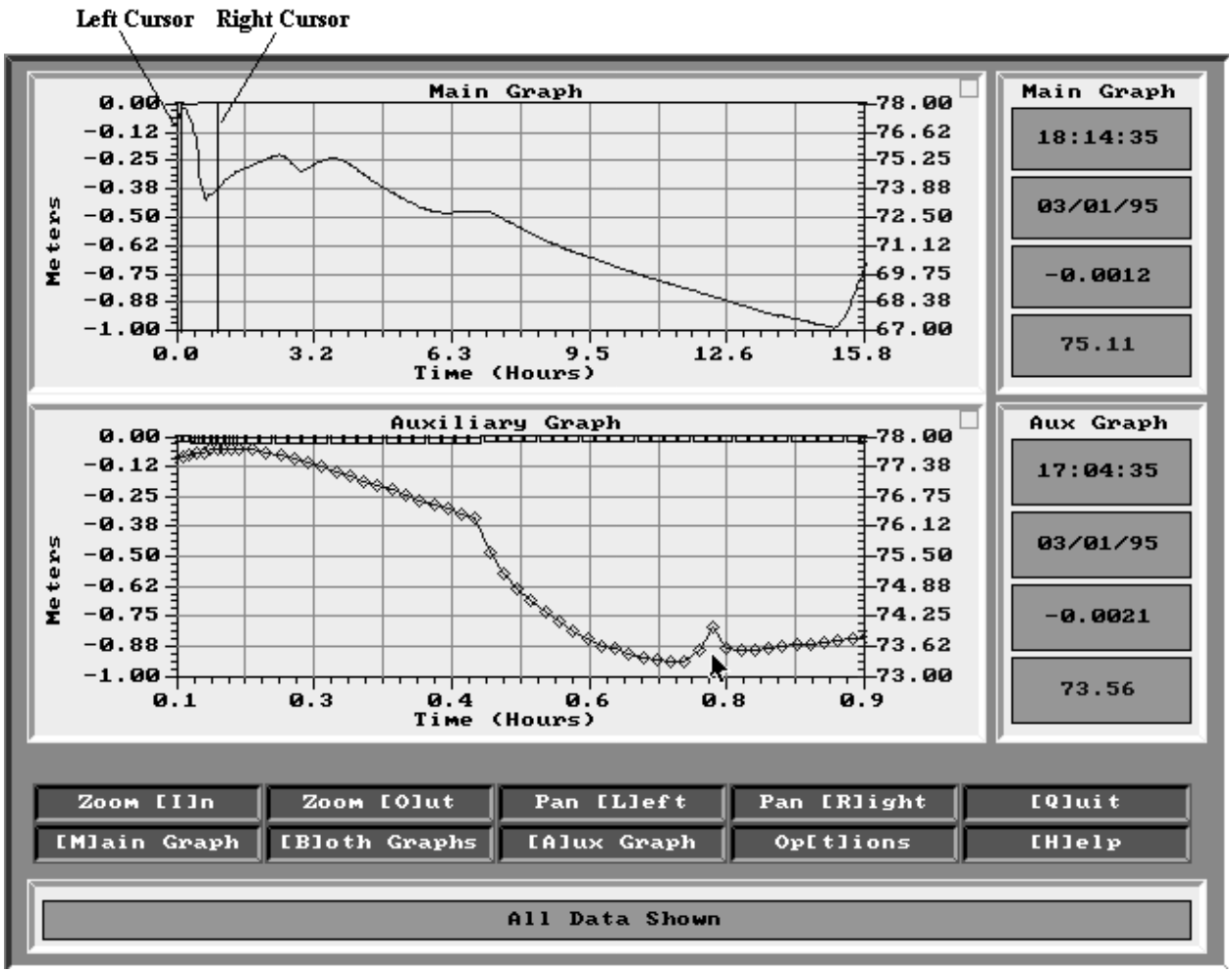

Figure 4-28. View Data Display

When in the "Both Graphs" mode of operation, the main graph will have a set of vertical lines used for cursors. The data between the cursors will be displayed on the auxiliary graph. The cursor on the left is the start cursor and the cursor on the right is the stop cursor. The cursors can be moved by using the Zoom In, Zoom Out, Pan Left, and Pan Right buttons. However, the cursors can also be moved directly with a mouse. Moving the mouse onto the main graph will cause the mouse pointer to change from an arrow to a cross hair pattern. While the cross hair pattern is displayed, the mouse can set the cursors directly. If the mouse is to the left of the start cursor and the mouse button is pressed, the start cursor will move to the mouse position. If the mouse is to the right of the stop cursor and the mouse button is pressed, the stop cursor is moved to the mouse position. If the mouse pointer is between the two cursors, the cursors will alternate on which one will move. Whenever a cursor is moved, the screen will update showing the cursor moved to the new position and the data on the auxiliary graph updated. Notice the software will not allow the start cursor to be placed on the right of the stop cursor.

Status Boxes:

The mouse can be positioned on a graph and the status box will show the information for that spot on the graph. The data shown in the status box will be the actual time and date the data at that point was taken, and the level and temperature at that point. The mouse must be on the graph to update the status information. If a graph is not displayed, the status box for that graph will indicate it is inactive.

Zoom In:

This button will only work if both graphs are displayed. This will move the cursors closer together and redisplay the data between the cursors on the auxiliary graph. This allows viewing sections of the data with greater detail.

Zoom Out:

This button will only work if both graphs are displayed. When selected, it will move the cursors farther apart and redisplay the data between the cursors on the auxiliary graph.

Pan Left:

This button will only work if both graphs are displayed. Both cursors will move an equal distance to the left.

Pan Right:

This button will only work if both graphs are displayed. Both cursors will move an equal distance to the right.

Main Graph:

This button will display only the main graph in a larger area. The status box for the main graph is still active, but the auxiliary graph status box is not.

Both Graphs:

This button will display both the main graph and the auxiliary graph on the same screen. In this mode the main graph will also have the cursors displayed. The Auxiliary graph will show all the data between the cursors. Both the main graph and the auxiliary graph status boxes will function in this mode.

Aux Graph:

This button will display only the auxiliary graph and in a larger area. The status box for the auxiliary graph is active, but the main graph status box is not.

Options:

This button allows options for you to modify and print the auxiliary graph.

Quit:

This button will cause the “View Graph” screen to close and redisplay the main screen.

Maximize:

Both graphs have a box in the upper right corner that when clicked on with the mouse, will use the whole screen to show the graph. To get the graph back to its normal size again, click on the square box in the upper right hand corner.

The "Graph Options" shown in Figure 4-29 allow some customization of the auxiliary graph. The changes made by these options will be displayed on the screen and a printed graph.

Titles:

The Auxiliary graph title is the only title that can be changed. This name is used as the title for the printed graph. When entering the graph mode, the Auxiliary graph will always be called Auxiliary Graph. It is foreseen that this will be changed to reflect the site or application, for example, "Well #23".

X Axis Time Base:

The X axis time base on the auxiliary graph will be displayed in the same units as the main graph. This default time base is computed based on the difference in time from the first data point to the last data point. If the auxiliary graph has been set to display only a portion of the main graph, it may be best to change the time base. The options are seconds, minutes, hours, days, and weeks.

Data Point Markers:

The graphs are made up by drawing a line from one data point to the next data point. When the Show Data Points option is enabled, a marker will be placed on the graph at the point that the data was actually logged. This is not very useful in the Linear logging mode, but is useful in all other modes because these modes may not log data at regular time intervals. Showing the data points is an easy way of seeing when data was actually logged.

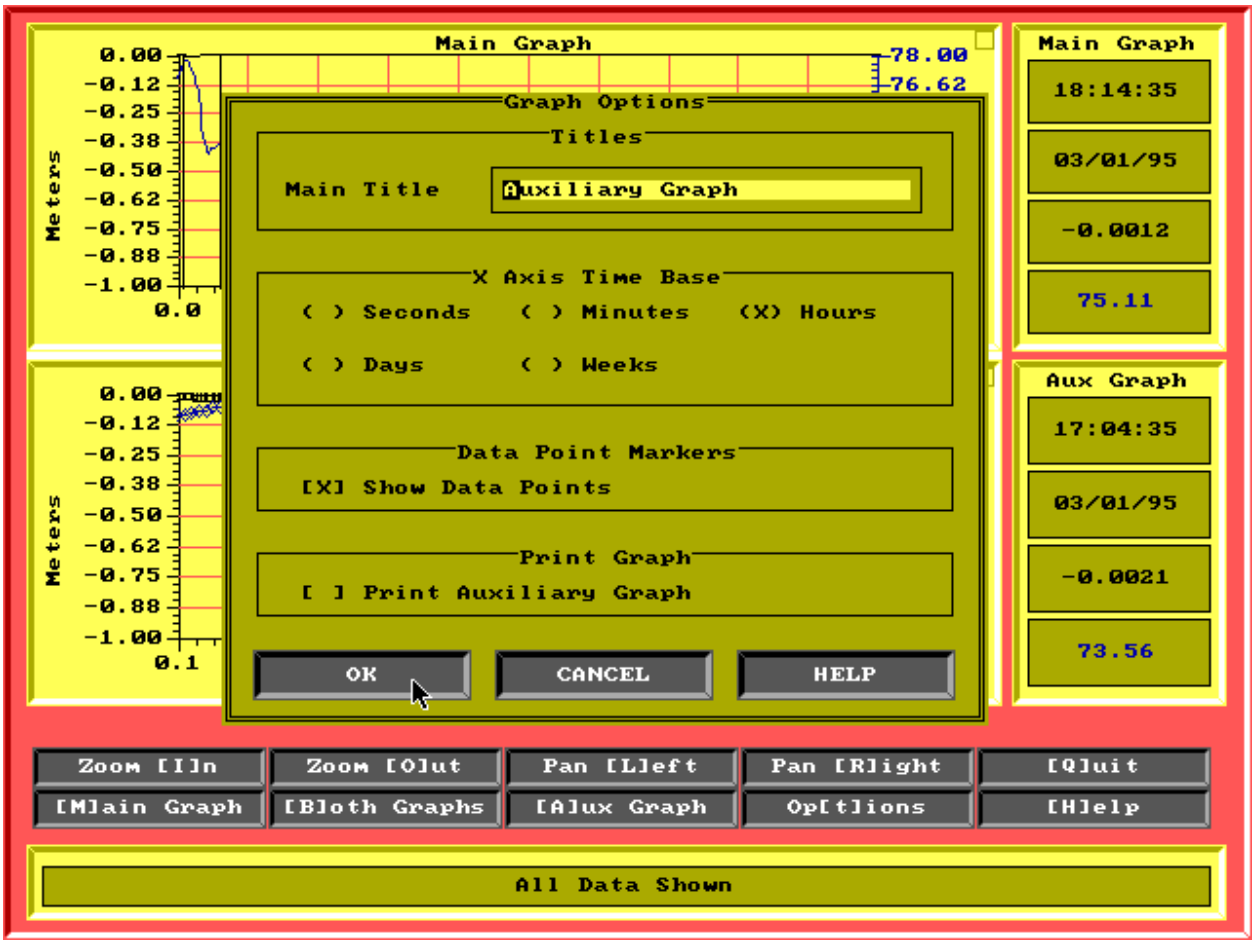

Figure 4-29. Graph Options

The auxiliary graph may be printed by turning on the "Print Auxiliary Graph" option. The auxiliary graph is the only graph that can be printed. Normally, you will make any desired adjustments in the graph and then print it. If you leave the auxiliary graph as it was first displayed, it will be the same as the main graph, with the exception of the graph title. This provides a way to print the main graph. When this option is enabled, another screen will be displayed allowing specific printing options shown in Figure 4-30.

Printer Type:

The "Printer Type" option is a list of printers supported by this software. The item at the top of the list is currently the active printer.

Printer Port:

The printer is expected to be connected to one of the parallel ports, LPT1 or LPT2. To print the graph, select the appropriate port. It is also possible to print the graph to a file and print it at a later time. If it is printed to a file, another window will pop up asking for a file name.

Paper Orientation:

The two options here are portrait and landscape.

Auto Form Feed:

When this option is selected, the printer will issue a form feed after the graph has been printed. Some printers will not print the last page until it gets a form feed, so the data for the graph will be in the printers buffer but will not print until you force a form feed. This option will cause the printer to print the graph by automatically adding a form feed at the end of the graph data. If this option is on and the printer sends out a blank page, then this option may need to be turned off.

These options normally only need to be set once. When these options are redisplayed, they should be the same as the last time they were used. However, when entering this screen the options should be checked to make sure they are correct.

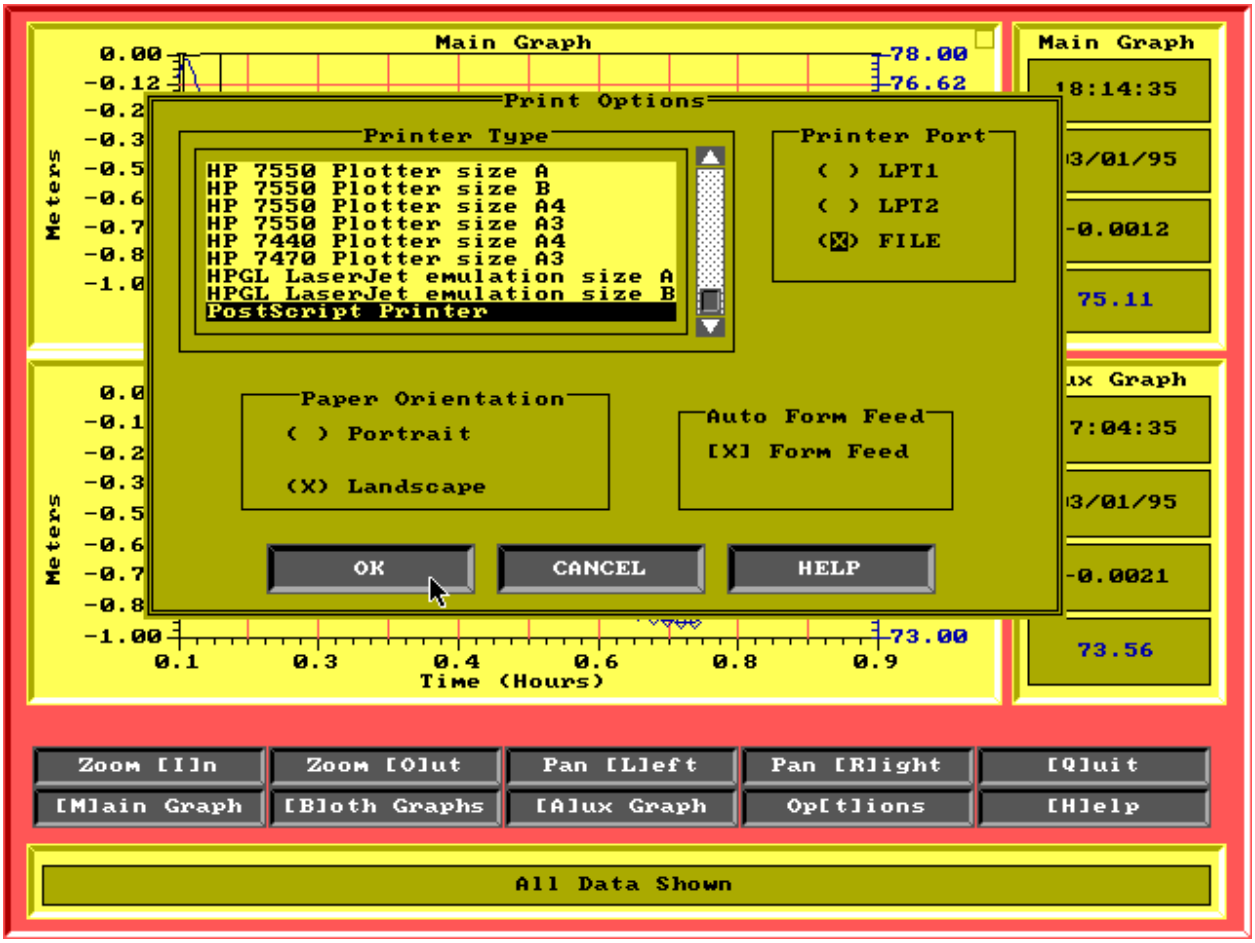

Figure 4-30. Print Options

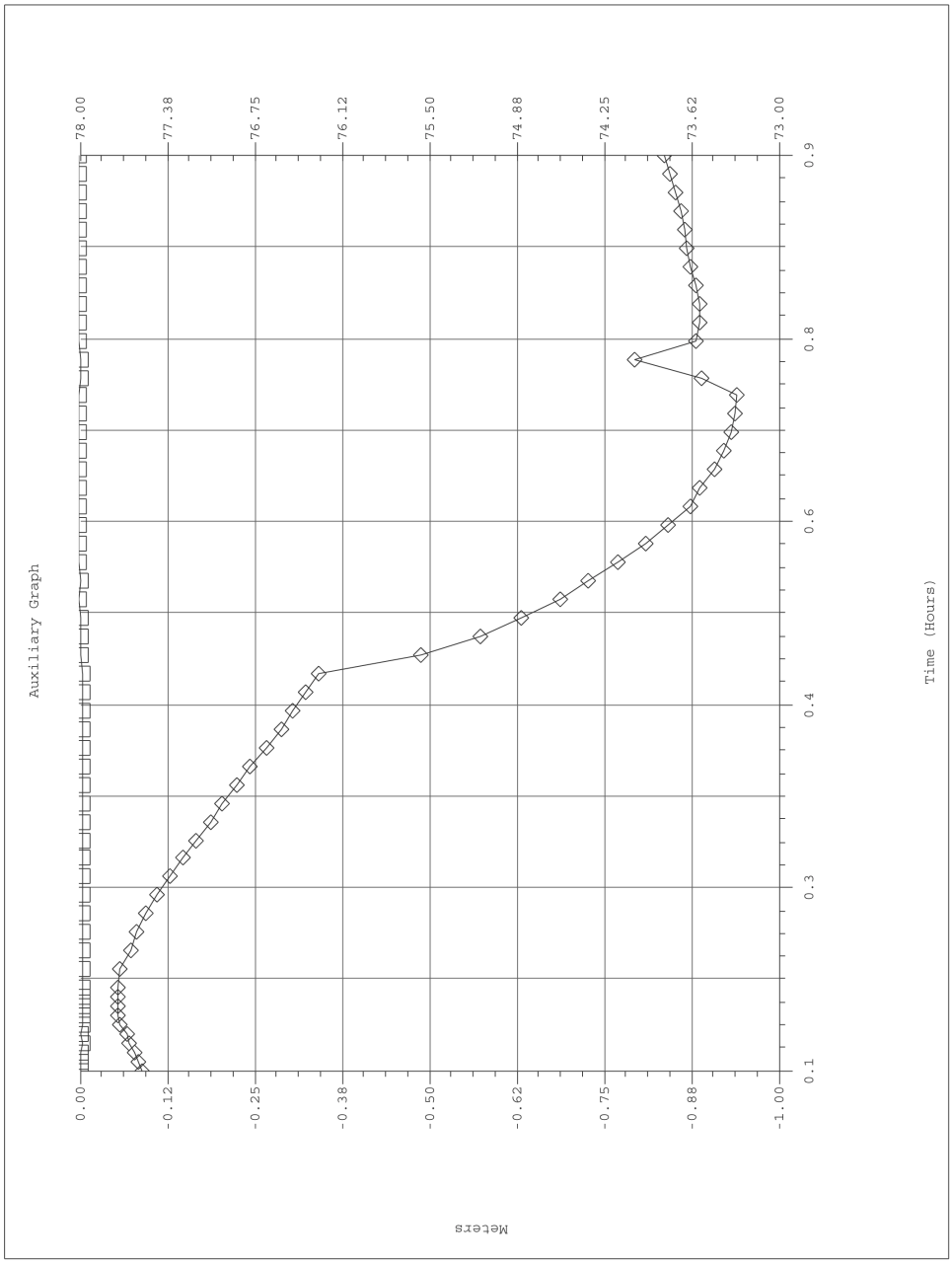

Figure 4-31. Printer Output

Figure 4-31 shows a typical graph of the "***WATER*LOG**" software program.

4.4.8 Measure Data Option

The Measure Data Option will cause the "***WATER*LOG**" to make a measurement as shown in Figure 4-32. The "***WATER*LOG**" makes the measurement and stores it in the FLASH EEPROM. The software in the computer will then query the "***WATER*LOG**" for the measurement which will be displayed in the bottom center window of the screen.

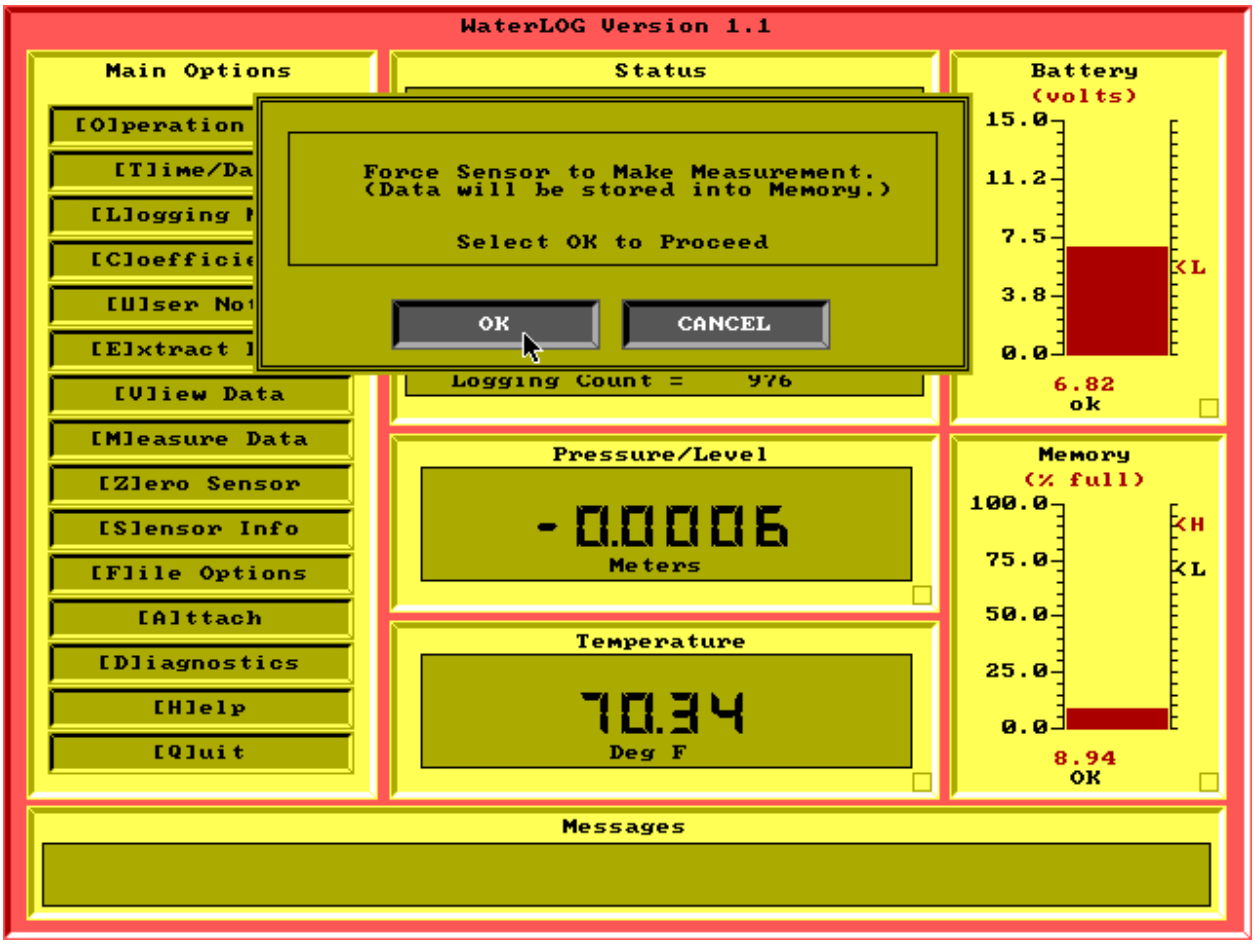

Figure 4-32. Measure Data Option

4.4.9 Zero Sensor Option

The "***WATER*LOG**" software allows you to force the sensor to use a specific point as its zero offset point. For example, placing the sensor in 5 feet of water and pressing Zero Sensor button will cause the sensor to record levels with a -5.0 foot offset. Figure 4-33 shows the option selected.

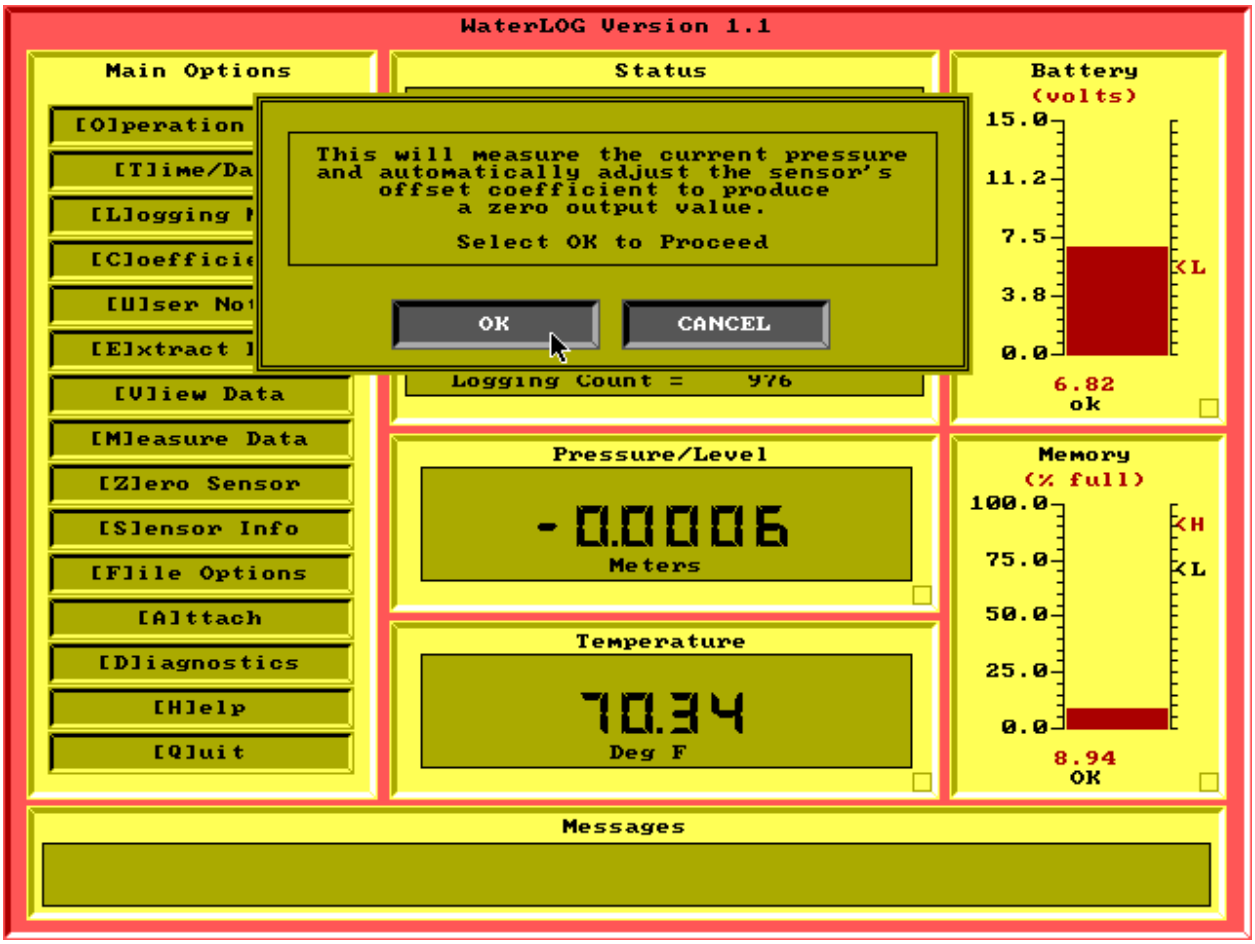

Figure 4-33. Zero Sensor Option

The Zero Sensor Option can also be used periodically to remove errors in pressure measurements due to long-term drift. To do this, remove the sensor from the water and allow it to settle for about 20 minutes (The sensor temperature will likely be changing rapidly so you must let it settle). Issue the Zero Sensor Option and the pressure output will go to very near 0.0000.

4.4.10 Sensor Information Option

You can see information about your "***WATER*LOG**" sensor as shown in Figure 4-34. The Vendor, Model Number, Firmware Version, Printed Circuit Board Serial Number, Serial Number, and Product Revision number are available for technical support purposes.

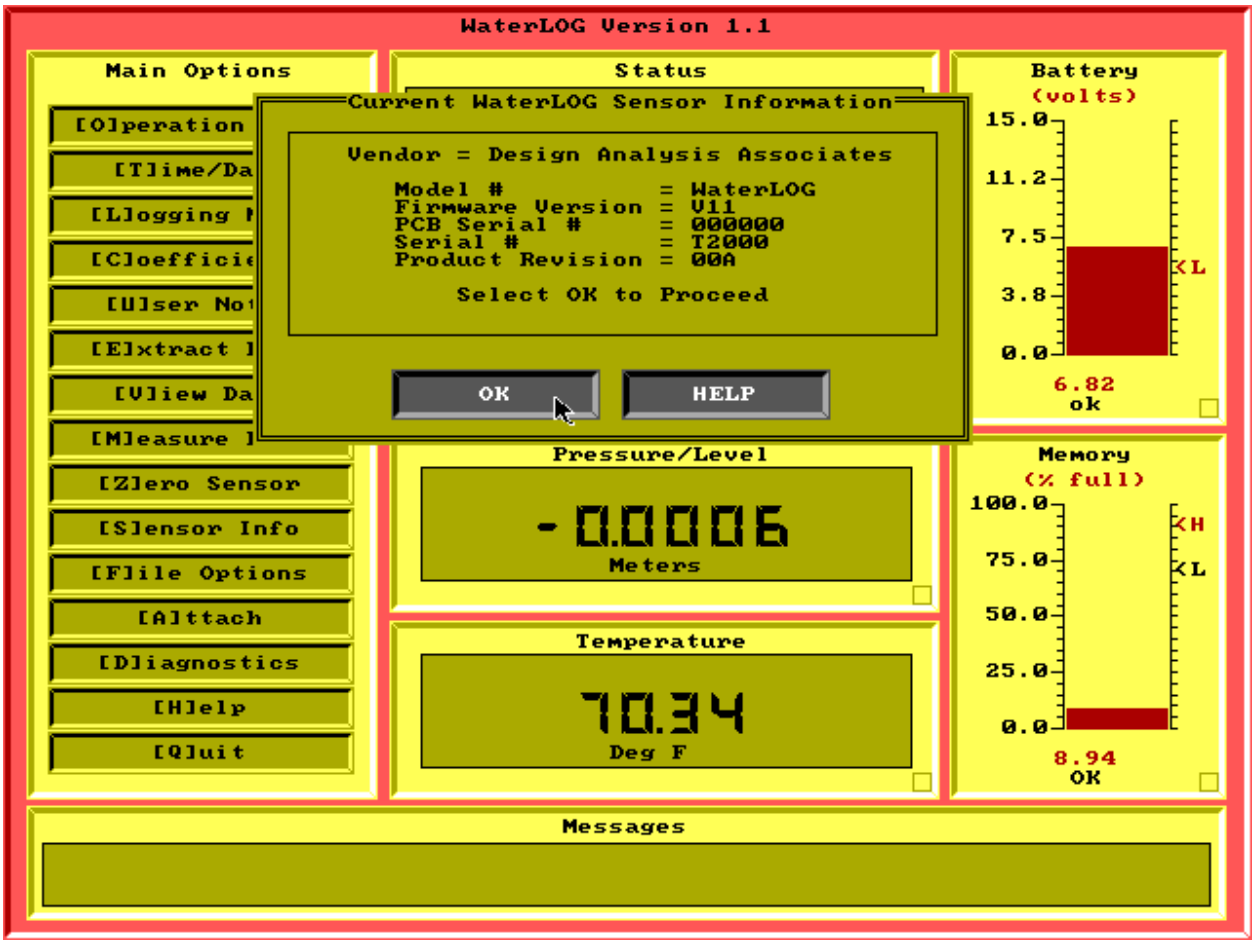

Figure 4-34. Read Sensor Information Option

4.4.11 Diagnostics Option

The Diagnostics option as shown in Figure 4-35 performs several tests on the hardware of the "***WATER*LOG**" sensor. This option is used to confirm that the sensor is working properly. The sensor must be in the reset mode before this option can be selected.

Note: Time, Date, User Notes and ALL DATA will be overwritten during this test. Extract any desired data before using this option.

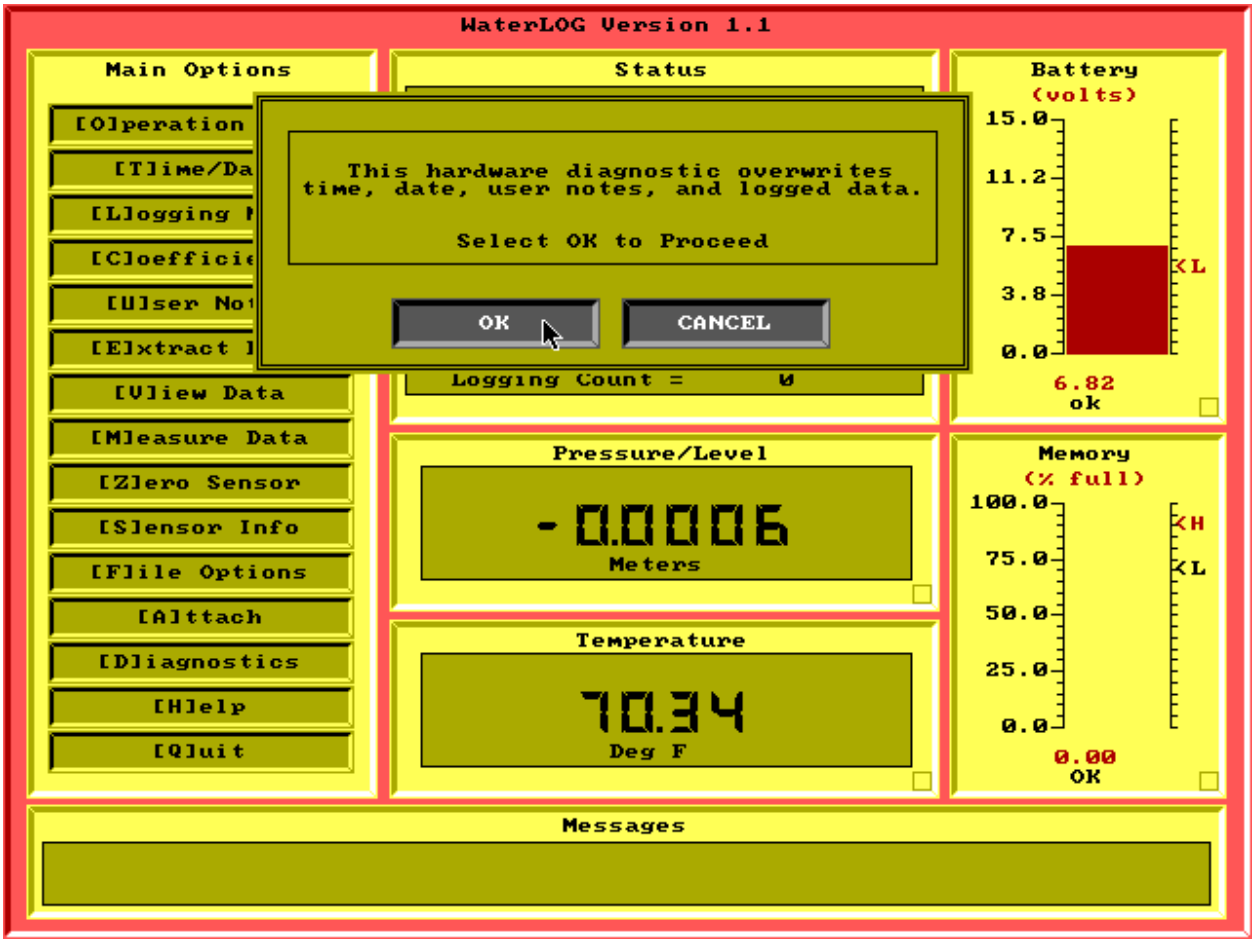

Figure 4-35. Self-Test Option

Figure 4-36 and Figure 4-37 show the results of the Diagnostics. The first line tests the CONFIG register to see if the processor's COP timer is enabled. The diagnostics software in the "***WATER*LOG**" then checks the program EEPROM memory for a correct checksum. The software then tests the RAM Memory, FLASH EEPROM memory, EEPROM user notes, and performs a measurement that returns pressure, raw pressure voltage, temperature, and raw temperature voltage. The results of the tests will be shown on the screen. After the tests have completed, you can press the OK button to return to the main menu.

Figure 4-36. Self-Test Diagnostic Display

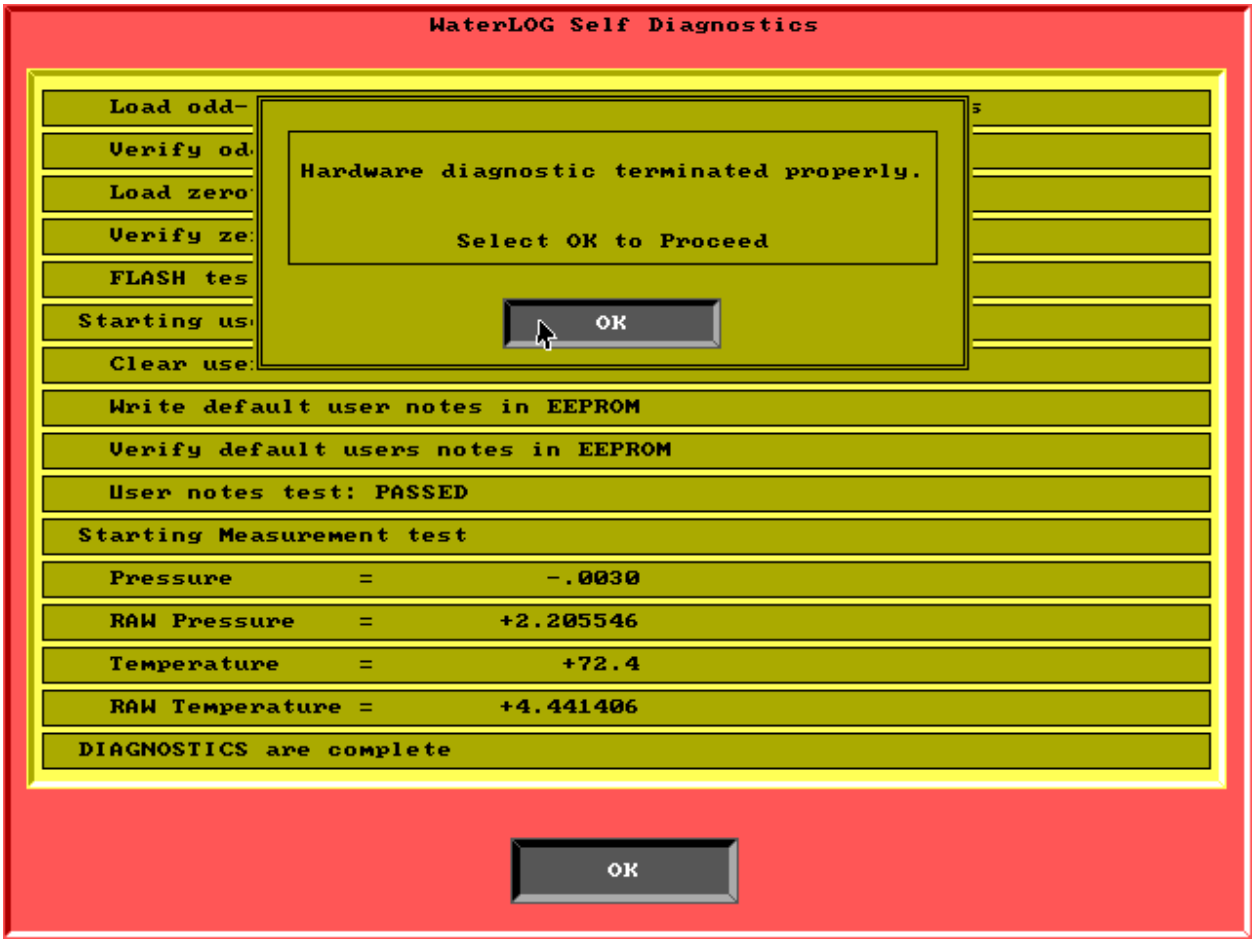

Figure 4-37. Self-Test Diagnostic Display

4.4.12 File Option

The File Options shown in Figure 4-38 provide the means to save the current settings to a disk file as a setup file, and to retrieve a setup file previously stored on disk. This makes creating, saving and retrieving setups very simple.

Setup information can be edited with or without a sensor being connected to the PC. There are some items in the main options that must have a sensor connected to operate, and these items are not saved to the setup file. There are also some options that always default to some value at startup, and are not saved. The list below shows the options that are not saved to a setup file.

Time and date functions.
Mode of operation.
Extract data.
Sensor information.
Force measurement.
Zero Sensor.
Diagnostics.
File options.

The options that are saved are listed below.

Logging modes.
Conversion options
User notes
View graph options

The setup files will automatically have a .WSF extension appended to them. The WSF stands for "***WATER*LOG**" Setup File. When retrieving a setup file, all *.WSF files in the selected directory will be displayed.

There is also a setup file saved every time the program is exited. This file is called WATERLOG.WSF and will be retrieved when the program is started again. This allows an interrupted session to be continued easily.

It is important to understand the operation of the software when the sensor is "attached" to the PC. Two steps are required to "attach" the sensor to the PC. First is the physical connection and second is the software connection. The physical connection consists of using a cable to connect the PC and sensor together. The software connection is done by using the "Attach" option. This sets up the software for communicating with the sensor. When the sensor is NOT attached, the software will work in a stand-alone mode allowing editing of the options that can be saved to and retrieved from a file. When the sensor is attached, all options are valid.

It is important to understand what happens when attaching to a sensor. When attaching to a sensor, the information in the sensor will be loaded into the "***WATER*LOG**" software, showing the state of the sensor. Any setups in the "***WATER*LOG**" software will be overwritten and lost. To prevent the loss of setups that are important, use the "File Save" option to save the setups before attaching to the sensor. To load setups that are saved as a disk file to the sensor, the sensor must first be attached and then the setup file retrieved. In this case, the retrieved setup file information will update the "***WATER*LOG**" software and will be sent to the attached sensor.

If a sensor is connected to the PC when the program is started, the WATERLOG.WSF is loaded, but the software will automatically attempt to attach to a sensor. If a sensor is "Attached", the information in it will overwrite the information loaded from the WATERLOG.WSF file (See section 4.4.13 for information on the Attach Option).

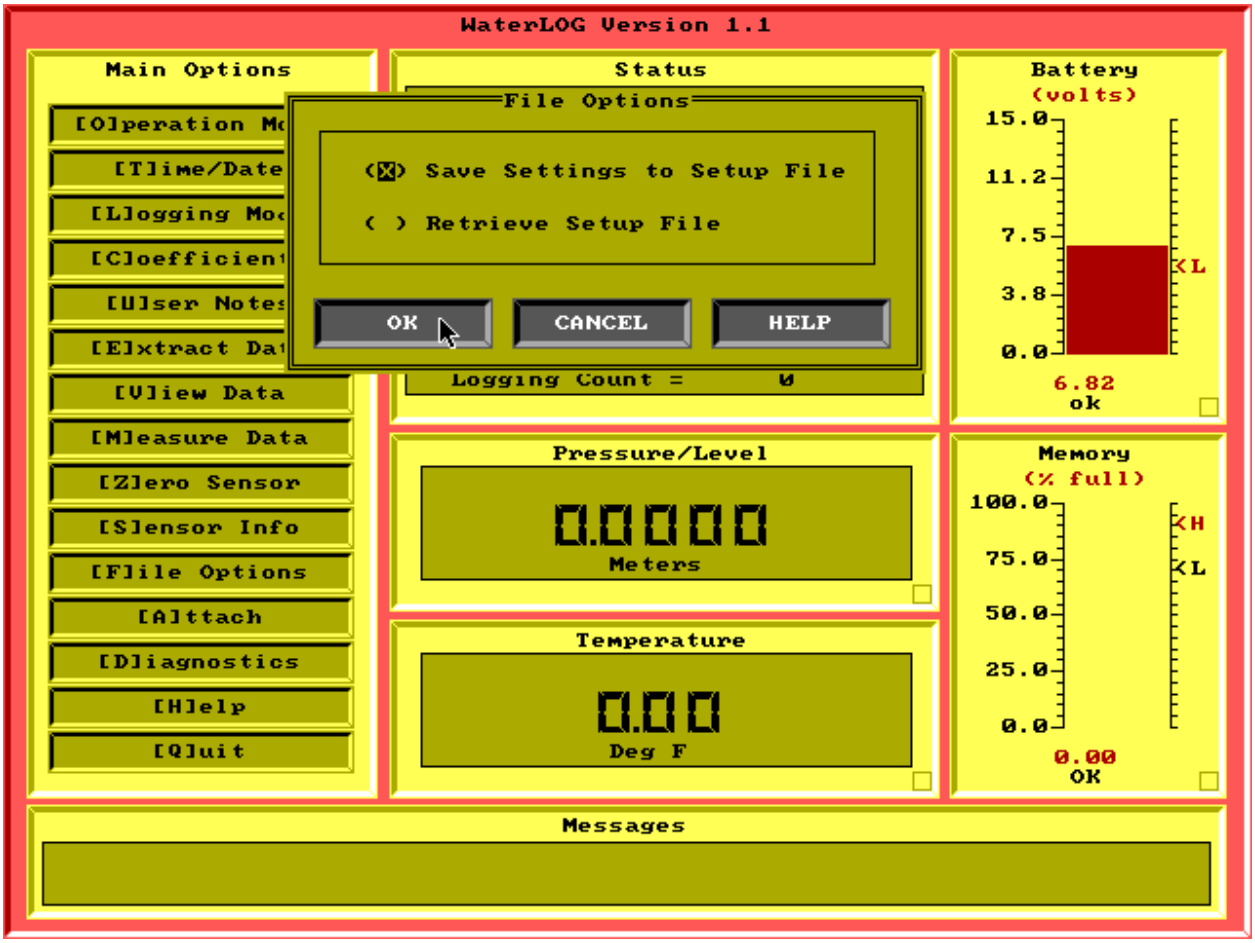

Figure 4-38. File Options

4.4.13 Attach Option

The Attach option shown in Figure 4-39 allows the "***WATER*LOG**" software to work in a stand-alone mode or while connected to the sensor.

To use the attach option, the sensor must be physically connected to the serial port of the PC. The "***WATER*LOG**" software is expecting a mouse (if used) to be on COM port 1, and the sensor to be connected to COM port 2. The action behind the "Attach" option is a software issue that links the PC "***WATER*LOG**" software to the software in the "***WATER*LOG**" sensor, so even though the sensor may be connected to the PC by a cable, they may not be "attached".

When attached, all changes are sent to the sensor as the changes are made on the computer. Sensor status information will be updated every 5 seconds. The "Working" message will be displayed in the message box on regular intervals.

If the sensor is not connected to the PC, the software is forced to the stand-alone mode.

In the stand-alone mode the "***WATER*LOG**" software will not display all status information of the sensor and it will not perform functions requiring the sensor to be connected. These functions include setting the time and date, forcing the sensor to make a measurement, zeroing the sensor, extracting data, setting the operation mode and sensor diagnostics.

The stand-alone mode is handy for setting up the majority of the options for the sensor while not connected or attached. The setups can then be saved to a disk file. It is important to save any desired settings to a file before attaching to the sensor because the setups in the sensor will overwrite the setups in the PC "***WATER*LOG**" software when it is attached. If the sensor is attached and a setup file is retrieved, the settings in the setup file will be transferred to the sensor.

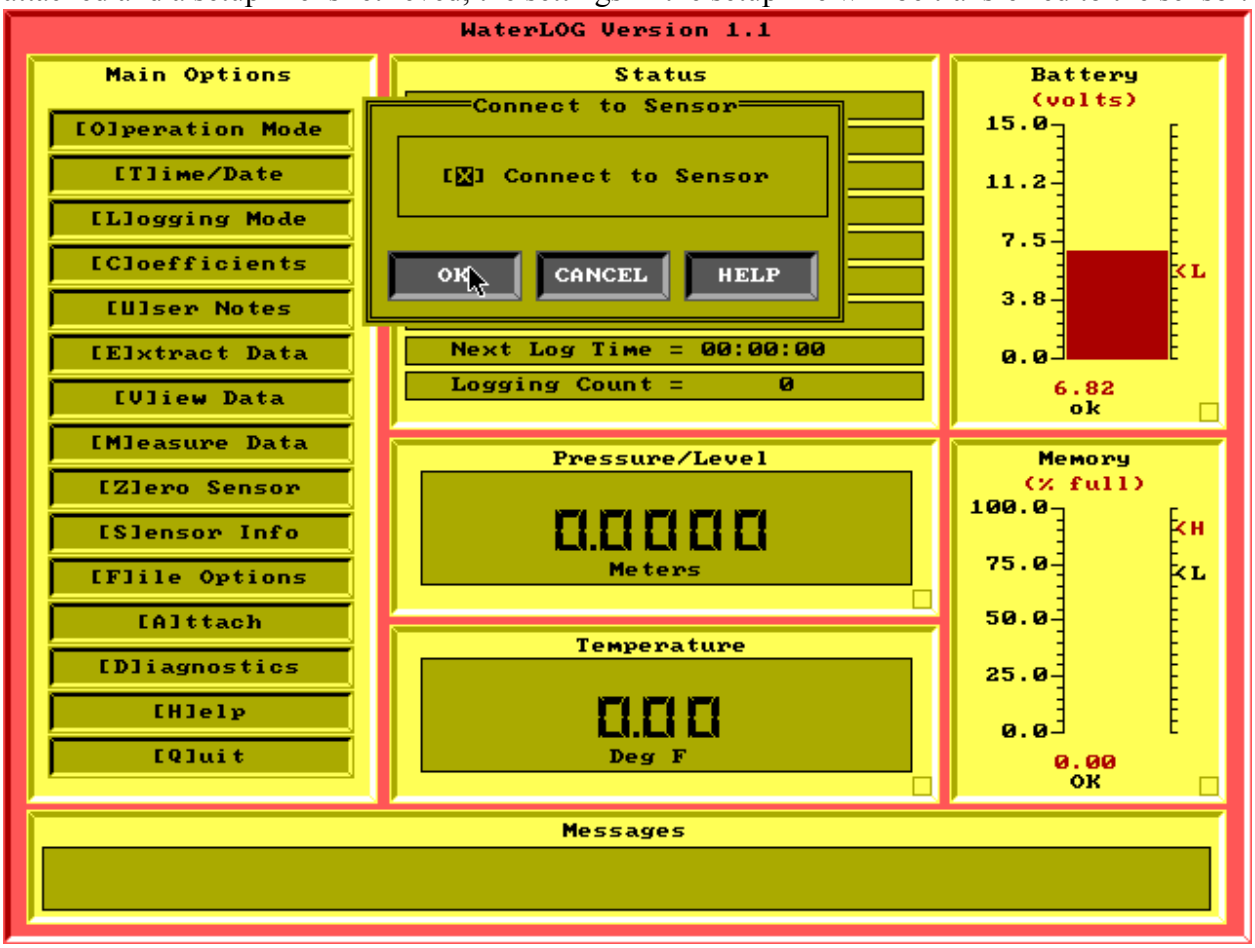

Figure 4-39. Attach to Sensor Option

4.4.14 Help Option

General Help shown in Figure 4-40 gives a basic understanding about the different functions of the "***WATER*LOG**" software.

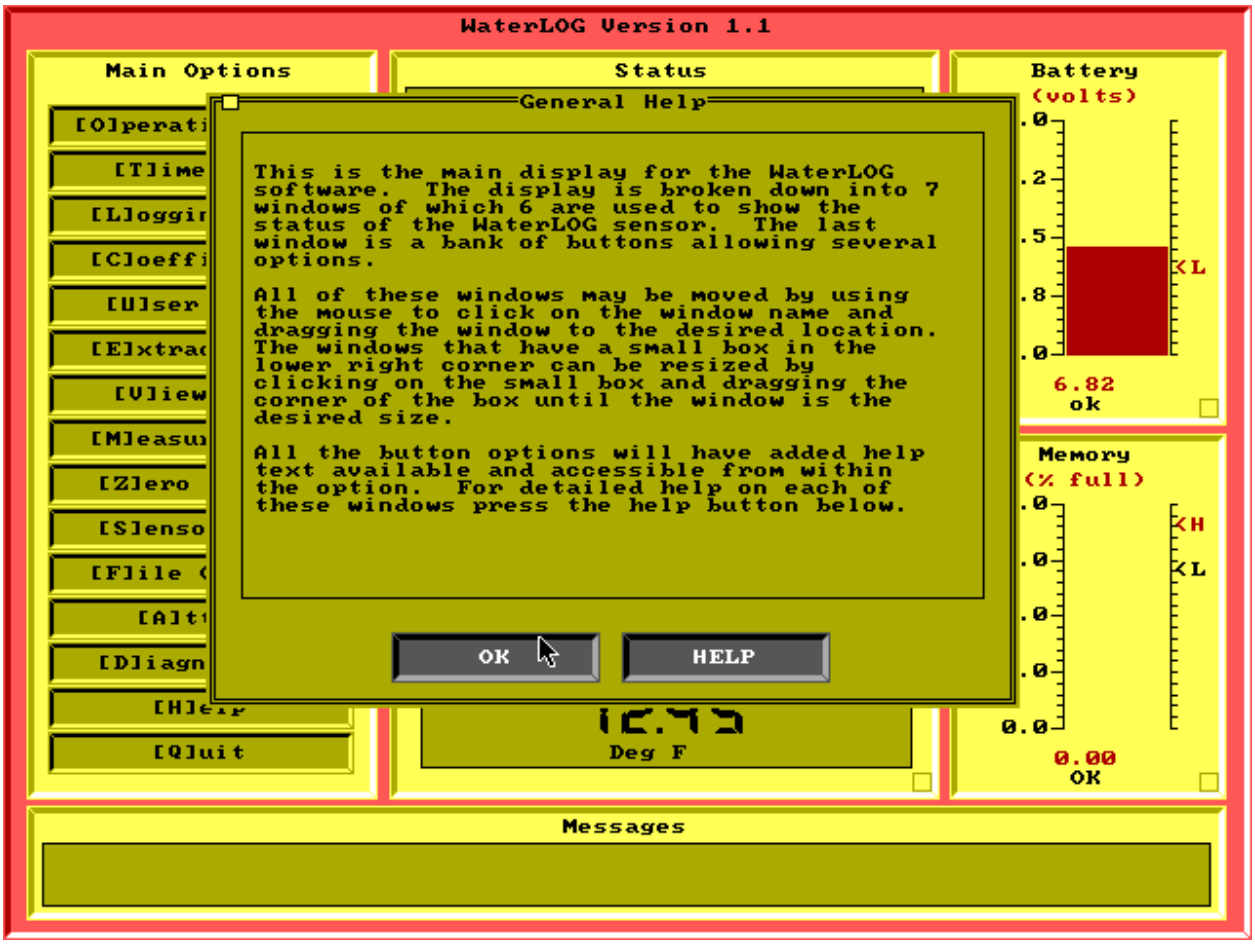

Figure 4-40. Help Display

Chapter 5
Guide to Data Analysis

Data is placed in a file on your DOS disk under the filename you specified with a ".DAT" extension when using option 8 from the main menu, using the Generic WaterGEN.EXE program, or using the Extract Option in the WaterLOG.EXE Program. Figure 5-1 shows the beginning segment of a file extracted from the "***WATER*LOG**". The first 18 lines of the file contain the serial number of the logger, the time of data extraction, the time the logging session was started, the sample rate, user notes, delta log value, hyper log value, and hyper divisor entered into the "***WATER*LOG**" when the logger was initialized. The next 3 lines contain the coefficients used in the "***WATER*LOG**" to transform the data to the correct format for pressure and temperature. The measurement data appears next in the file. Each line of data contains the date, time, Julian day, pressure, temperature, and battery voltage for a given sample.

Normally, the FLASH EEPROM will contain all of the data. However, when the EEPROM is full, the "***WATER*LOG**" will begin writing over the oldest data. You can avoid losing data by specifying a sufficiently long sample rate, or extracting the data from the "***WATER*LOG**" more often. It is probable that a data wrap-around occurred if the Memory Used display shows 100.0% when you attach the computer to the "***WATER*LOG**" for data extraction.

The data file can be read into your analysis software for the various plots and graphs you may require.

```
"WaterLOG Logging Module (All data extracted)"
"Serial Number : T2000"
"Extracted     : 08:11:18 03/02/95"
"Logger Started: 16:20:00 03/01/95"
"Logging Rate #1 : 00:00:05, Samples :   19"
"Logging Rate #2 : 00:00:30, Samples :   20"
"Logging Rate #3 : 00:01:00, Samples :    0"
"Logging Rate #4 : 00:01:00, Samples :    0"
"Logging Rate #5 : 00:01:00, Samples :    0"
"Logging Rate #6 : 00:01:00 (final)"
"User Notes"
"     WaterLOG Down Hole Data Logger     "
"                From                    "
"    Design Analysis Associates, Inc.    "
"   Logan, Utah  84321  (801) 753-2212   "
"Delta Log =            0"
"Hyper Log =            0"
"Hyper Divisor =   1"

"Coefficients  y = b0 + b1*x"

"Pressure,    b0 =           0 ,b1 =     0.703665 ,Units = Meters "
"Temperature, b0 =          32 ,b1 =          1.8 ,Units = Deg F  "

"Date"       "Time"     "Day" "Pr(Meters )" "Tmp(Deg F  )" "Batt. Voltage"
"03/01/1995" "16:20:00"  059,  -0.0039,       76.89          6.8
"03/01/1995" "16:20:05"  059,  -0.0040,       76.88          6.8
"03/01/1995" "16:20:10"  059,  -0.0039,       76.90          6.8
"03/01/1995" "16:20:15"  059,  -0.0039,       76.91          6.8
"03/01/1995" "16:20:20"  059,  -0.0039,       76.90          6.8
"03/01/1995" "16:20:25"  059,  -0.0039,       76.92          6.8
"03/01/1995" "16:20:30"  059,  -0.0039,       76.93          6.8
"03/01/1995" "16:20:35"  059,  -0.0039,       76.96          6.8
"03/01/1995" "16:20:40"  059,  -0.0039,       76.97          6.8
"03/01/1995" "16:20:45"  059,  -0.0039,       76.97          6.8
"03/01/1995" "16:20:50"  059,  -0.0038,       76.99          6.8
"03/01/1995" "16:20:55"  059,  -0.0038,       77.00          6.8
"03/01/1995" "16:21:00"  059,  -0.0038,       77.02          6.8
"03/01/1995" "16:21:05"  059,  -0.0038,       77.02          6.8
"03/01/1995" "16:21:10"  059,  -0.0038,       77.02          6.8
"03/01/1995" "16:21:15"  059,  -0.0038,       77.03          6.8
"03/01/1995" "16:21:20"  059,  -0.0037,       77.04          6.8
"03/01/1995" "16:21:25"  059,  -0.0038,       77.05          6.8
"03/01/1995" "16:21:30"  059,  -0.0037,       77.05          6.8
"03/01/1995" "16:21:35"  059,  -0.0037,       77.06          6.8
"03/01/1995" "16:22:05"  059,  -0.0036,       77.11          6.8
"03/01/1995" "16:22:35"  059,  -0.0038,       77.17          6.8
"03/01/1995" "16:23:05"  059,  -0.0039,       77.21          6.8
"03/01/1995" "16:23:35"  059,  -0.0039,       77.25          6.8
```

Figure 5-1. Sample Data File Extracted from the "***WATER*LOG**" Logger/Sensor.

Chapter 6
Maintenance/Trouble Shooting

6.1 Maintenance

The **"*WATER*LOG"** was designed to be a low maintenance instrument. The batteries should be monitored, and will need to be changed when the voltage gets below 5.5V. The **"*WATER*LOG"** was designed mainly to be used in an unattended mode to prolong battery life. If you use the **"*WATER*LOG"** for long periods of time connected to a computer, or if you make rapid measurements (less than 8 seconds) for extended periods of time, you will drastically reduce the life of your battery pack. For such applications, you should consider using an external battery or power supply. For questions concerning the use of an external power source contact the factory. You should also monitor the desiccant packs and the dry air filter which are located in the battery/dry air chamber. The frequency of maintenance is a function of the Relative Humidity in your area. We recommend that you check the desiccant at least every 3 to 6 months while you determine the necessary frequency of maintenance. (See section 2.3 "Accessing the Battery Pack and Desiccant") Dry desiccant will have a dark blue color and will turn pink as it becomes saturated.

As with any precision instrument, the calibration should be checked on a regular basis. We recommend that the **"*WATER*LOG"** be factory calibrated on a yearly basis in order to maintain the highest level of accuracy. However, the **"*WATER*LOG"** can be field calibrated. This can be done using some pressure standard as a reference and the Slope and Offset coefficients to make the required adjustments. The accuracy achieved by field calibration is a function of the calibration standard and many other variables. A field calibrated instrument may not meet the manufacturer's specification for accuracy.

6.2 Trouble Shooting

It is unlikely that this manual will ever contain trouble shooting tips to cover every problem that will be encountered. Feedback from customers is very valuable and greatly aids in the quest for constant product enhancement. Please feel free to call the factory for technical assistance and also with solutions you have found to past problems.

Our experience with pressure transducers has taught us a lot about the problems associated with field deployable equipment. The following list of problems and possible solutions will undoubtedly grow with subsequent revisions of this manual and may be helpful to you.

No Response

1) Verify power to the **"*WATER*LOG"**.
2) Make sure you have connected the RS-232 cable properly.
3) Make sure that you invoked WaterLOG.EXE with the COM port that you connected the RS-232 cable to.

Intermittent Data

1) Verify your power supply or battery voltage. As the power supply approaches the lower threshold of the **"*WATER*LOG"** supply range, it may begin to miss readings intermittently.

Artificially High or Low Data

1) If you have entered a Slope and/or Offset in the user coefficients, verify that they are calculated and entered correctly.
2) Verify that the elevation of the **"*WATER*LOG"** has not moved.

Appendix A
Specifications

SENSOR SPECIFICATIONS

Accuracy

(Maximum percent of error in measurement)

Pressure: For measurement intervals less than 8 seconds: better than ±0.05% of full scale output (FSO) over temperature range referenced to a straight line stretched from zero psi to maximum pressure.

For measurement intervals 8 seconds or greater: ±0.03% of FSO.

Temperature: Internal temperature ±1 °C over temperature range.

A/D Resolution

(Smallest change detectable in output signal)

Pressure: 1 part in 250,000 (0.0004%)

Temperature: 1 part in 250,000 (0.0004%)

Output Resolution (Displayed)

Pressure: 0.0001 psi

Temperature: 0.01 °C

Linearity

Less than 0.02% deviation from a straight line referenced to end points.

Pressure Hysteresis

Less than 0.03% of FSO.

Long-term Stability

Accuracy drift is less than ± 0.05% of FSO per year.

Range

Pressure	Depth		Accuracy 0.05%	0.03%
0 to 5 psi	0 to 11.53 feet	±0.006 feet	±0.003*	
0 to 15 psi	0 to 34.60 feet	±0.017 feet	±0.010	
0 to 30 psi	0 to 69.20 feet	±0.035 feet	±0.021	

*0 to 5 psi is now a custom range

Pressure Overload: Up to 2 times the rated pressure.

Environmental Restrictions

Operating Range: 0 to 40°C (nonfreezing)
Compensated Range: 0 to 40°C
Storage: -10 to 70 °C
Extended Range: Consult Factory

Media Compatibility

Liquids and gases compatible with PVC, Polyethylene, Stainless Steel and Ethylene Propylene.

Pressure Port

Stainless steel screen with 149 micron filter, field replaceable.

LOGGER SPECIFICATIONS

Communications Interface

Stored data is extracted via an RS-232 or RS-485 connection at 9600 baud, 8-bit with no parity, 1 stop bit.

Capacity

Memory: Nonvolatile FLASH Memory, 128Kbytes, upgradable to 256Kbytes
Number of
Data Points: 43,688 Data Points typical for 128Kbytes (logging date, time, pressure, temperature and battery voltage)
Upgradable to 256Kbytes (87,376 data points typical)

User Notes: 160 ASCII characters

Logging Modes

Types of Logging:

Time Linear: Programmable from 1 second to 24 hours

Linear Δ: Logs on 1 second to 24 hour intervals. Logs data dependent on a change specified by user. This mode conserves memory.

Linear Hyper: Logs on 1 second to 24 hour intervals. In this mode important events are not likely to be missed. Data is collected at up to 256 times the normal logging rate when a user defined rate of change is exceeded.

Linear Hyper Δ: Logs on 1 second to 24 hour intervals. This mode minimizes memory use and prolongs battery life by adjusting the logging rate as defined by user entered rate of change.

Variable: Allows user to define Logarithmic / Variable logging intervals, 6 user definable intervals. (Ideal for well testing and other applications.)

Zero Offset Command

Allows user to set offset to zero either at zero pressure or at a datum or reference point.

GENERAL SPECIFICATIONS

Power Supply

Primary Source:	2 Lithium cells at 3.6 V, 13.5 AH each (User Replaceable)	
	Or Alternate External Sources Ranging from 6V - 15V	
Current Drain:	Sleep Mode:	600μA (max)
	Active Mode:	75mA (max) @7.2V with computer connected

Dry Air System

A desiccant filled dry air filter prevents moisture from condensing in the "***WATER*LOG**," this provides automatic compensation for changes in atmospheric pressure without impairing the sensor's accuracy.

Sensor Cables

"***WATER*LOG**" to Surface Mounting Enclosure:

Field spliceable 1/4" vented cable allows quick reference to atmospheric pressure and minimizes the chances of vent blockage by particulates or kinks which are problems inherent to smaller vent tubes.

Vented, shielded, three-wire cable; 10 foot standard length (longer lengths are available if required).

Surface Mounting Enclosure to PC or I/0 Device:

The I/0 connector on the mounting enclosure provides an easy interconnect to Lap Top, Palm Top, PC or Field terminal, etc.

Mechanical Data

Material:	Non-compressible and non-corrosive engineering plastics with polyethylene vent tubing	
Size:	Probe:	1.425" maximum diameter x 12" long
	Well Head Assembly:	1.950" maximum diameter on tube with 2.25" top cap x 22.4" overall length

Designed to fit in **2" (OR LARGER) WELL BORES.**

The "***WATER*LOG**" includes a surface mounting enclosure which includes battery, RS-232 communication electronics and dry air system. These facilities can be packaged for various applications such as well top and stream gauging. (Consult factory for information on well and stream gauging installation packages.)

Warranty

The "***WATER*LOG**" is warranted against defects in materials and workmanship for one year from date of shipment.

Note: Specifications outlined above are subject to change without prior notice due to an ongoing commitment to testing and product improvement.