



**WELL SOUNDER 2000  
USER MANUAL**

# WELL SOUNDER 2000 USER MANUAL

## TABLE OF CONTENTS

PRODUCT OVERVIEW .....	3
PRODUCT SET UP .....	4
OPERATION.....	5
FUNCTION CHARTS.....	6
MODE DESCRIPTIONS .....	8
REMOTE OPERATION.....	10
DOWNLOADING DATA .....	11
INTERPRETATION OF DATA.....	12
ERROR CODES .....	13
SPECIFICATIONS.....	14
ADDITIONAL NOTES.....	15
WARRANTY AND SERVICE.....	15

## PRODUCT OVERVIEW

The Well Sounder 2000 is a simple to use self-contained portable acoustic ranging instrument designed specifically to find the distance through a pipe or bore hole to an obstruction which could be the surface of water in the hole or the dry bottom.

The product consists of a control unit and a probe. The control unit contains the driver electronics, processor, display, keypad and 6 AA batteries. Internal non-volatile memory is included to record system settings, calibration data, and log up to 14,976 data points. A real-time clock/calendar is also included to time stamp the recorded log data. The RS232 port can be set to output data to a remote device or used as a bidirectional communications interface to a computer for remote programming or data download. A power jack allows the unit to be run from an optional AC adapter or battery pack.

The probe contains a speaker, a microphone and temperature sensor in the probe tip. The probe is designed to easily attach to a standard well cap vent opening while also allowing the display unit to be operated in a convenient location up to 6 feet away.

The Well Sounder transmits an acoustic pulse into the pipe, then measures the time to the returned echo. The distance is calculated as the result of the sound speed and the time. Since the sound speed has a large temperature dependence, a temperature sensor is included in the probe to adjust for variations.

Accessories for the Well Sounder 2000 can be found on our website at [www.wellsounder.com](http://www.wellsounder.com).



## PRODUCT SET UP



Remove the product from its case and follow these steps:

**CONFIRM POWER SOURCE:** The control unit ships from the factory with batteries installed. To access the batteries, remove the four screws at the rear of the case and open the cover. The unit may also be operated by an AC adapter or external battery pack attached to the power connector on the bottom of the unit. The external power should supply between 7 and 12VDC at 50ma using a type M connector.

**CONNECT CONTROL UNIT AND PROBE:** Attach the probe plug to the jack on the bottom end of the control unit.

**ATTACH TO WELL:** Attach the probe to the well by inserting the tapered end of the probe into the vent hole in the well cap. If the well does not have a cap, the well casing can be covered with any flat piece of material, i.e. plastic or cardboard, with a small hole into which the probe fits snugly. It is not necessary that the probe connection be air tight. The probe will work best when the probe tip reaches into the well cavity.

The unit is now ready to operate.

## OPERATION

A complete description of all functions can be found in the Mode Definitions section of this manual.



**POWER ON TO DEPTH DISPLAY:** Press the ON button located on the front panel of the control unit. The probe will pulsate and the LCD screen will display the default operating screen. The depth is displayed on the top line. Press the arrow buttons to view additional information displayed on line two such as the battery voltage, the optional flow meter, or the temperature sensor.

*Note: If error conditions exist, line two of the display will be replaced by an error message. See the ERROR CODES section for details.*

**ACCESS DISPLAY MODE:** Press the DISP button to view the data log and the system date and time. While the date and time are displayed, press SET to edit the date and time. Use the arrow buttons to adjust the information. Press DISP to return to the depth reading. Press SET while the depth or log are displayed to cycle through the system options. Press DISP at any time to return to the depth reading.

**ACCESS SET MODE:** Press the SET button to view and change any of the system settings. There are 17 settings. Continue to press SET to scroll through all of the settings. Press DISP to return to the depth reading.

1. Product Info	2. Unit ID	3. Well Temp
4. Flow Clear	5. Offset	6. Range
7. Alarm	8. Logging	9. Log Rate
10. Log Change	11. Dump Log	12. Clear Log
13. RS232	14. Baud Rate	15. Units
16. Power Mode	17. Factory Reset	

**SCROLL:** Press the Up or Down arrow button to scroll through the information displayed on the LCD screen for both the SET MODE and DISPLAY MODE.

**LOG A DEPTH READING:** Press the LOG button to record a reading for that point in time. This information is added to the data log (if enabled.) Press DISP to view the data.

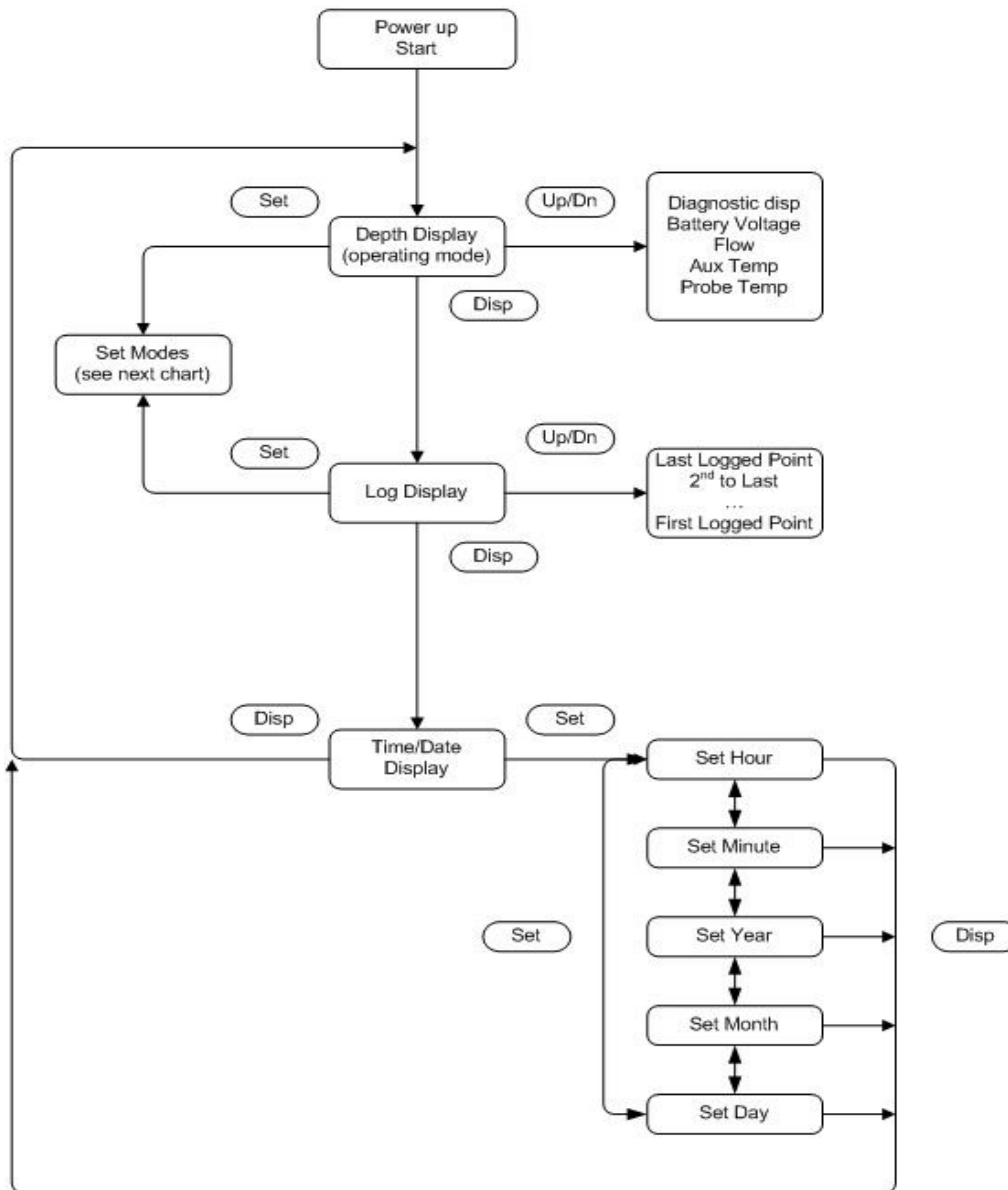
**POWER OFF:** Press the OFF button located on the front panel of the control unit. All system settings as well as the time and date, and log data are maintained while the power is off.

*Note: The ENTER button is currently not in use.*

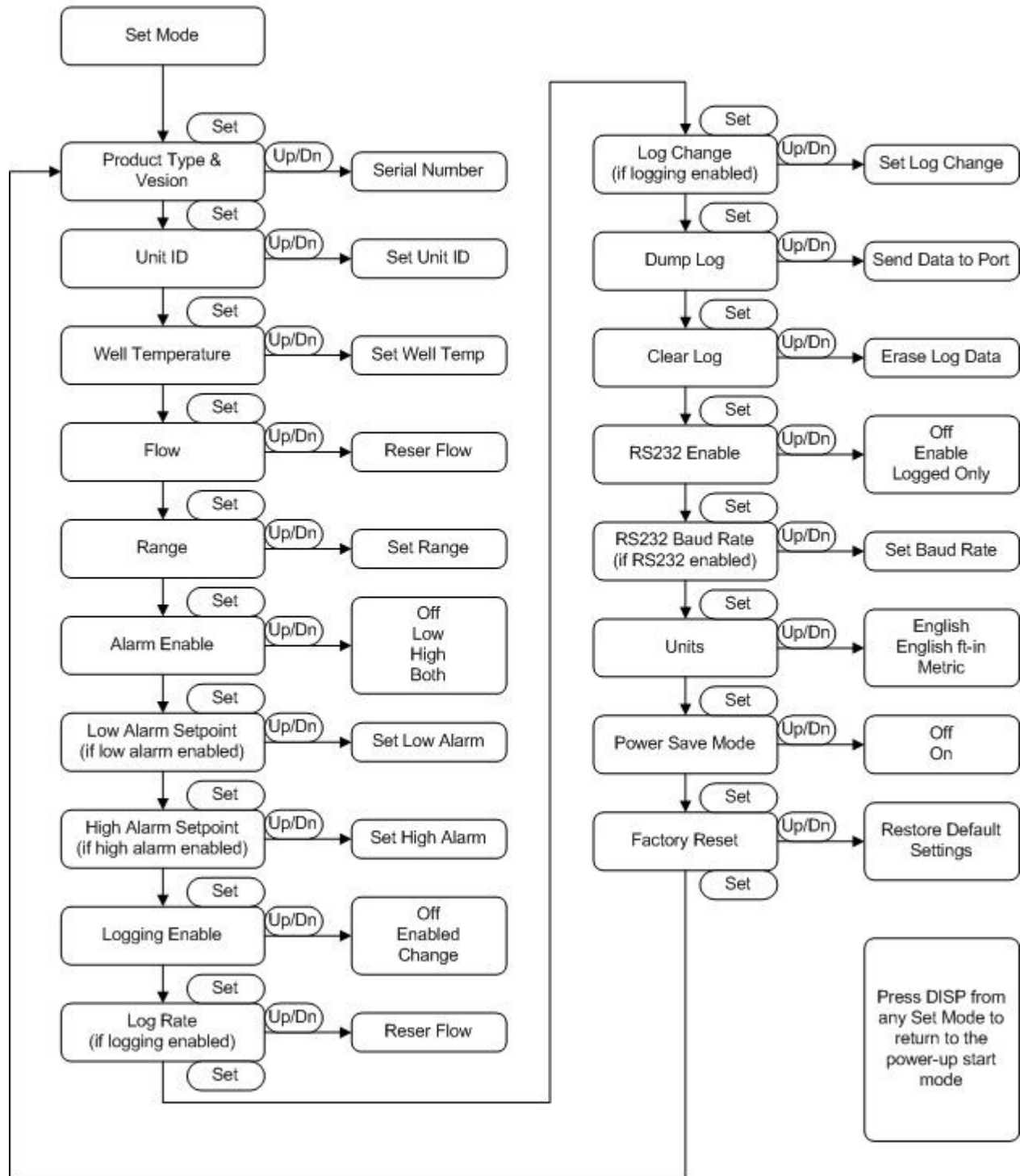
## FUNCTION CHARTS

The settings for the DISP MODE and SET MODE are diagrammed in the following charts. A name in the oval indicates the button to be pressed on the unit.

### DISPLAY MODES



## SET MODES



## MODE DESCRIPTIONS

**DEPTH DISPLAY** –The default display mode after power-up. While this display is active, the unit is operational, sending pulses and timing the echoes. The depth is displayed on the top line and user selectable information is displayed on the second line. The depth is displayed at every update but may be erratic until the signal is locked in. Data displayed on the second line can be changed by pressing the up or down arrow. Data available varies depending on options enabled on each unit. If there are any error conditions, such as a missing probe, or low battery voltage, an error message will be displayed on the second line.

**DIAGNOSTIC DISPLAY** – One of the data options on the DEPTH DISPLAY mode shows the two correlation coefficients: the signal strength for the transmitted and returned echo signal. In normal operation the first coefficient will be in the range 10-30 and be larger than the second. If the second is larger, it may indicate that the unit is locking on to an erroneous reflection from a breakout in the well, or that the top of the well is not closed tight enough. Similarly, the first signal strength should be in the range of roughly 250-400 and the first should be larger than the second. If not, it could indicate that the well is deeper than the range, excessive noise in the well or a problem with the probe itself.

**LOG DISPLAY** – The first data display in the DISP MODE, provided that logging is available on the unit, allows the user to review the logged data. The first data point shown is the last point measured, and displays the sequential number for the point, the depth reading, and the date and time stamp. Other points are displayed by pressing the up or down button. Rapid scrolling is activated by holding the up or down button.

**TIME AND DATE DISPLAY** – The second data display in DISP MODE shows the time and date on the internal clock. The time is in 24 hour format. Press the SET button while viewing the time to change the system time and date. Press the SET button to cycle through the time and date. Press the DISP button to return to the DEPTH DISPLAY.

**PRODUCT TYPE** – This SET MODE feature displays the product name and the software version number. The unit serial number is displayed by pressing the up or down button.

**UNIT ID** – This SET MODE feature displays a user selectable ID number in the range 0-255. Set the unit ID number by pressing the up or down button.

**WELL TEMPERATURE** – This SET MODE feature is entered by the user to indicate the deep temperature in the well. If you do not know the well temperature, reference the Water Temperature Data Table found on our website. The temperature near the surface is automatically sensed by the probe. These two temperatures are used to calculate the sound speed and in turn, the distance.

**FLOW** – This optional SET MODE feature displays the totalized flow, provided the flow sensor is installed and enabled. Pressing the up or down button resets the totalizer to zero.

**OFFSET** - This SET MODE feature is a user selectable offset added to each measurement to adjust to an alternate reference datum. For example if the well casing extends 18 inches above the ground surface and readings are desired with reference to the ground level, an offset of -1.5 feet would be entered as the offset.

**RANGE** – This SET MODE feature sets the pulse rate and in turn the maximum range detectable. A shorter range means more frequent pulses and faster updates.

**ALARM** – This SET MODE feature allows the user to indicate an alarm for a water depth reading that is too high and/or too low. Press the up or down button to enable or disable either of the two alarms. The high alarm is activated if the water level in the well is higher than the high alarm set point. The low alarm is activated if the water level is deeper than the low alarm set point. An activated alarm displays as an error in the second line of the default display and also as an error code in the RS232 output. Additionally if the optional alarm output is installed, it is also activated.

**LOW ALARM SET** – If the ALARM is enabled, this SET MODE features allows the user to set the depth at which the low alarm is activated.

**HIGH ALARM SET** - If the ALARM enabled, this SET MODE feature allows the user to set the depth at which the high alarm is activated.



## MODE DESCRIPTIONS, con't

**LOGGING** – This SET MODE feature activates the data logging functionality. Press the up or down button to select the logging preference. Two logging modes are available: Enable or Change. Enable sets the unit to record data each period. Change sets the unit to compare data each period against the last logged data. The new data point is stored in memory if the measurement has changed more than the log change margin (as defined in the Log Change mode.) The logging function requires that data pass a consistency check before being accepted as valid data. When the log flag is enabled, a log message is displayed on the error line and remains until valid data is recorded.

**LOG RATE** – This SET MODE feature determines the time interval in minutes between logged data points in the range 0 to 60 minutes. Every measurement is recorded if it is set to zero.

**LOG CHANGE** – This SET MODE feature is available when logging is set to “change”. This margin determines the distance that the depth must change to record the new log data. If the new data is within the margin of the last recorded data, then the new data is discarded.

**DUMP LOG RS232** – This SET MODE feature sends all of the logged data to the serial port. Press the up or down button to send the data. Ensure the cable is connected to the RS232 port.

**CLEAR LOG** – This SET MODE feature displays the number of data points collected in the log out of the total number of data points allowed. Press the up or down button to erase all data from the log and free the memory for additional logging.

**RS232**– This SET MODE feature activates the transmission of data over the serial port. Press the up or down button to make the selection. Two serial modes are available: Continuous and Logged Only. When set to Continuous, every measurement is sent over the serial port. When Logged Only is selected, data is only sent when it is logged. Transmitted data includes the time, date, and all measured data, and the highest priority error code. Select Off to deactivate this feature.

**RS232 BAUD RATE** – This SET MODE feature is activated when the RS232 feature is activated. Press the up or down button to select available serial baud rates. The default is 19,200. The data format is always 8 bit with 1 stop bit.

**UNITS** – This SET MODE feature allows the user to select the appropriate measurement system for the data. Press the up or down button to scroll through the options: English for decimal feet, degrees Fahrenheit and gallons; English ft-in for distance displayed as feet and inches; or Metric for meters, degrees Celsius, and liters.

**POWER MODE** – This SET MODE feature activates the power save function. Press the up or down button to scroll through the options: Normal or Power Save. When logging data and the Power Save function is activated, the unit is shut down between logging periods. Battery life can be extended by more than 6 times using this function.

**FACTORY RESET** – This SET MODE feature allows the user return the unit to the default configuration. Press the up or down button to make the selection.

## REMOTE OPERATION

Connect the unit to a computer or other RS232 device using a standard straight through serial cable. A simple serial to USB adapter is available to use with laptops without serial ports. Using a standard terminal emulator program such as HyperTerminal or Tera Term Pro 2.3 (available for free download), set the port and baud rate. If the unit is in power save mode and shut down, press a key on the keypad to wake the unit. It will remain awake for 30 seconds after the last key or RS232 command. Then press the return key <return> on the computer. If it is set up correctly, the unit should respond with a WS2k> prompt. The unit is now ready to receive commands from the remote device or computer.

The remote commands are case sensitive and must be entered exactly as shown on the list below. One command per line terminated by a <return>. Extra tabs or spaces will not be accepted.

### Examples:

Press "d<return>" to dump the log data to the screen. Open a log file (or capture text) on the terminal emulator prior to entering this command to record the data on the computer.

Press "u0<return>" to set english mode or "u2<return>" to set metric.

Press "lp5<return>" to set the logging period to 5 minutes.

Press "tm15:30:00<return>" to set the system time to 3:30 PM.

If serial output is enabled, the prompt and input will be written over on the screen but the input will still be interpreted correctly. It may be easier to disable the serial output while using remote commands. Press "s0<return>" to turn off serial reporting and "s1<return>" to turn in back on when finished.

### USER COMMANDS:

In the following list:

[iiii] indicates a parameter of up to a 4 character integer (no decimal point).

[dddd] indicates up to 5 character decimal number (decimal point optional).

<ret> indicates a return.

a0<ret>	alarm off
a1<ret>	low alarm on
a2<ret>	high alarm on
a3<ret>	both alarms on
ah[iiii] <ret>	set high alarm level
al[iiii] <ret>	set low alarm level
cX<ret>	clear log
d<ret>	dump log
ff[dddddddd] <ret>	preset flow totalizer
i[iii] <ret>	set unit ID
l0<ret>	logging off
l1<ret>	logging on
l2<ret>	log on change
lp[iiii] <ret>	logging period minutes
lm[dddddd] <ret>	log change distance
o[dddddd] <ret>	offset to add to all distance measurements
p0<ret>	power saver off
p1<ret>	power saver on (CAUTION – while in power down, RS232 is off and no further communications will be accepted)
r[iii] <ret>	set max measurement range
s0<ret>	turn off RS232 reporting
s1<ret>	turn on RS232 reporting
s2<ret>	turn on RS232 reporting for logged points only

**REMOTE OPERATION, con't**

sb[i] <ret>	set baud rate 0 – 300 1 – 1200 2 – 2400 3 – 4800 4 – 9600 5 – 14400 6 – 19200 7 – 38400 8 – 57600
tm[hh:mm:ss] <ret>	set time
td[dd/mm/yy] <ret>	set date
u0<ret>	set english units (ft)
u1<ret>	set english units (ft in)
u2<ret>	set metric units
w[dddddd] <ret>	set well temperature
Ca[dddddd] <ret>	calibrate temp sensor 1
Cb[dddddd] <ret>	calibrate temp sensor 2
Cc[dddddd] <ret>	calibrate temp sensor 3
Cd[dddddd] <ret>	calibrate battery sensor
?<return>	send a list of the current settings
<return>	send current data

Most of these commands are the same as those described under Mode Definitions. There are, however, a couple additional functions.

The calibrate commands allow the user to calibrate the unit for use with a particular probe. Each probe is slightly different, so while the unit is measuring a temperature, for example, the command “Ca73.1<ret>” could be entered. This would cause the unit to recalibrate so that it would currently read 73.1 degrees.

The flow command allows the user to preset the flow totalizer with up to a ten digit decimal number.

**DOWNLOADING DATA**

The procedure for collecting data from field installed logging units in power save mode should be as follows:

- 1 – Connect the laptop computer to the unit using a serial cable.
- 2 – Start a terminal emulator program such as HyperTerm or Tera Term Pro 2.3
- 3 – Set the Com Port (usually Com 1), and the data format to 19200 baud, 8 bit, 1 stop bit, parity none and flow control to none.
- 4 - .Press the “SET” button on the unit to wake it up. There should be a single click.
- 5 – Press <enter> on the computer, and the unit should respond with a line of data and a WS2k> prompt. If not, press again.
- 6 – If the unit is sending continuous lines of data, press “s0<return>” to turn it off.
- 7 – Open a log file in the terminal emulator.
  - In HyperTerm, click on the “transfer” drop down menu and select “capture text”.  
Enter a file name and click open. A log indicator will light up at the bottom of the screen.  
When finished, go back to the “capture text” menu and select “stop”.
  - In Tera Term Pro 2.3, click on the “file” drop down menu and select “log..”.  
Enter a file name and click open. A log file program bar will be added at the bottom of the screen.  
When finished, open this program bar and click “close”.
- 8 – Press “?<enter>” on the keyboard if desired to include the unit information in the log.
- 9 – Press “d<enter>” on the keyboard to start the download. The last data line will be followed by END.
- 10 – Close the log file as described in item 7.
- 11 – Press “cX” to clear the data log to make room for additional data logging.
- 12 – Disconnect computer. In 30 seconds, the unit should go back to sleep and resume logging.

## INTERPRETATION OF DATA

### DATA QUERY

A simple <return> sent to the unit instructs the unit to send the current data set. Each data element is preceded by an upper case letter for the identity of the following number as follow: data, time, D depth, other data, B battery voltage and the R error code. (see the error code section for codes).

Other data includes any enabled options which are reporting valid data. This may include the T probe temperature, X external temperature, and F flow.

Example:

```
WS2k >
2008/07/21 10:12:06 D 74.45 T 76.4 F 0.00 B 5.97 R 2
WS2k >
```

This indicates that the depth is 74.45 feet, the probe temp is 76.4 F, the flow is 0 gal, the battery voltage is 5.97, and the error code is 2 meaning that the battery voltage is low.

### SYSTEM STATE

A "?" command sent to the unit instructs it to send its current operating state. This will include 3 lines of data. The first line reports the model number and features, the software version, the unit serial number, and the user set ID number. The second and third lines report the applicable system settings prefixed by the commands used to set them as listed in the table in the section on external commands. In addition to the settings is the log memory state prefixed with "ls" and includes the number of log points in memory/ total number available. So in the following example 168 points have been used out of 14975.

Example:

```
WS2k > ?
Mod #WS1100-1023 Ver # 1018 Ser #080628015 ID #001
t2008/07/21 10:12:33 l0 lp15 lm 0.30 s0 r 700.00 o 0.00 p0 u0
ls 168/14975 a0 al 100.00 ah 100.00 w 60.5
WS2k >
```

In this example, "l0" indicates that logging is turned off, "lp15" indicates that the logging period is 15 minutes, and the well temperature is set to 60.5 degrees.

### DATA DUMP

The "d" command instructs the unit to send the contents of the data log. The information is sent one data point per line and is formatted like the data query with the exception that there is no error code.

Example:

```
WS2k > d
Log Dump
2008/07/03 11:28:26 D 120.33 F 0.00 B12.84
2008/07/03 11:34:35 D 120.27 F 0.00 B12.84
2008/07/03 11:47:55 D 120.27 F 0.00 B12.84
2008/07/03 12:03:46 D 120.21 F 0.00 B12.84
End
```

```
WS2k >
```

**ERROR CODES**

1	No probe	The unit does not see the temperature sensor in the probe.
2	Low Battery	The input voltage has dropped below 6.5V. The unit will continue to function properly until the voltage reaches about 5.4V. Once the battery voltage reaches 6.5V there is less than 10% battery life remaining
3	FP	An internal processor over run is occurring. May indicate an internal fault.
5	CC	An internal processor over run is occurring. May indicate an internal fault.
6	Log Full	Indicates that the internal log memory has been filled and no additional logging will be performed. The log memory must be cleared to continue.
7	RS232 over run	The command line reached the end of the buffer without identifying a command.
8	Probe Error	Indicates that the signal levels received from the probe are outside the normal range. This could be caused by a probe not installed in a well, excessive noise, or a faulty probe.
9	Low Level Alarm	Indicates that the well water level has dropped below the low alarm set point. The alarm will continue until the level increases, the alarm is disabled, or the set point is changed.
10	High Level Alarm	Indicates that the well water level has increased above the high alarm set point. The alarm will continue until the level decreases, the alarm is disabled, or the set point is changed.

## SPECIFICATIONS

### POWER:

External Power (optional) – 5.5 to 12VDC at 50ma. Do not exceed 16V. Connector 5.5mm x 2.1mm center post positive.

Internal Power – 6 AA Alkaline batteries. The unit will run continuously for approximately 80 hours on a set of batteries or up to 21 days in power saver mode.

Real time clock – Li Ion 3V battery CR2032.

### MEASUREMENT:

Resolution - .05 ft

Accuracy - .1 ft, (see notes)

Range – 9 to 700 feet.

### LOGGING:

Memory – nonvolatile flash memory for 14976 data points in addition to calibration and user data.

Logging rates – 1 sec to 60 minutes per sample.

### ENVIRONMENTAL:

Temperature – -10 to 110 F

Humidity – 10 to 90% non-condensing.

### PHYSICAL:

Dimensions – 4x7.5x1.25"

Control Unit Weight - ~14 oz with batteries.

Probe Weight - ~5.5 oz.

### FEATURES:

Display – 2x16 character LCD

Temperature compensation – in probe

Alarms – high and low 10 to 700 ft.

Serial Output – baud 300 – 57600, 8 data bits, one stop bit. (19200 baud default).

### INPUTS:

Acoustic probe

Flow meter input (with adapter) – pulse counting.

Temperature sensor input

Serial port

### OUTPUTS:

Serial port

Alarm

## ADDITIONAL NOTES

The specified accuracy is achieved provided certain conditions are met. Since the distance calculation is determined by timing the returned echo, it is important that a free path is available for the pulse to travel to the water surface and return. It is possible that an obstruction such as torque arrester or centering ring on a pump pipe can cause a premature echo. It is also possible that a breakout or large fracture opening can also cause a false echo. Ordinary pump piping and wiring will not interfere with the measurements.

The accuracy is also dependent on the sound speed in the well. Since the sound speed is determined by the temperature, the average temperature must be specified correctly. The error is approximately .1%/°F.

The maximum range is limited by the maximum time during which the echo is monitored, and the strength of the echo signal. Uncased wells drilled through very porous material can attenuate the signal faster than the rated distance.

## WARRANTY AND SERVICE

Eno Scientific warrants to the user that all products manufactured by Eno Scientific, will be free from defects in workmanship and materials for 1 year from the date of shipment.

Eno Scientific warrants to repair or replace any such defective equipment or part (determined to our satisfaction to have a defect in workmanship or original material) upon receipt and inspection of such defective equipment to Eno Scientific with all shipping pre paid by the user.

In no event shall Eno Scientific be liable for any direct, indirect or consequential damages, abuse, acts of third parties (rental equipment), environmental conditions or other expenses which may arise in connection with such defective equipment. This warranty shall not apply to damage of equipment caused by incorrect installation, usage, storage alteration or inadequate care.

This warranty does not apply to parts, assemblies or devices not manufactured by Eno Scientific which are covered by other manufacturers' warranties. There are no warranties except as specifically provided in writing herein.

Contact Eno Scientific with any warranty or service questions.

For additional information, please visit our website at [www.wellsounder.com](http://www.wellsounder.com).