Model
H-330 / H-331

WATERLOG® SERIES

Owner's Manual

Model
H-330 / H-331

SDI-12 Output
Shaft Encoder

WATERLOG® SERIES

Owner's Manual

NOTICE

Document Number: H330/331
Document Authors: Michael Nelson
Revision: 1.2

75 West 100 South
Logan, UT 84321 USA
Phone: (435) 753-2212
Fax: (435) 753-7669
Internet: www.waterlog.com

Table of Contents

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.

2. ACKNOWLEDGMENTS BY USER

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.

4. LICENSE

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
Operation

1.1 Introduction

The ***WATER*LOG**® H-330/331 is a digital shaft encoder which measures water depth by monitoring the position of a float and pulley. The H-330/331 is easy to use and works with any SDI-12 data recorder. For older loggers, ALERT systems and the weather service LARK the H-330/331 has a quadrature output that is compatible with Handar 436A type shaft encoder. The "Serial-Digital Interface" is ideal for data logging applications with the following requirements:

- Battery powered operation with minimal current drain
- Low system cost
- Multiple sensors on a simple three wire cable
- Up to 250 feet of cable between a sensor and the data recorder (Use of H-423, SDI-12 to RS485 converter extends the range to 1000's of feet)
- 200 counts per revolution for the SDI-12 output

The following features also make the H-330/331 a wise choice:

- The H-330/331 scales the encoder position into user units of feet, meters, etc.
- Precision dual bearing design with special low temperature lubricant
- Threaded shaft compatible with older mechanical shaft encoders.
- Zero backlash
- Sealed enclosure protects from moisture and dirt
- Low current operation (less than 800 microamps typical standby)
- High speed encoder circuitry prevents missing counts due to rapid float movement from wave action or sudden movement in freeze/thaw conditions - 15 ft/sec typical
- Water resistant connectors provide easy hookup.

The H-331 has the same functionality as the H-330/331 with the addition of a built-in display and manual offset adjustment feature making it easier to setup and use in the field. Additional features of the H-331 are as follows:

- Continuous display readout always shows last measured value.
- 'Read' button causes the H-331 to continuously update the display while the button is pressed.
- The Adjust knob allows the user to manually set the stage.
- The Adjust knob allows the user to manually set the sensor SDI-12 address.

NOTE: Sections of the manual that refer to the H-330/331 are also valid for the H-331.

1.2 Operation

The H-330/331 is a precision shaft encoder with a resolution of one part in two hundred (0.005 ft). The H-330/331 has a microprocessor controlled digital counter. The microprocessor monitors two digital outputs from a shaft position sensor. The outputs generate "quadrature" pulses and phase information. This phase information indicates which direction the shaft is turning. As the shaft encoder rotates the two signals change with a unit distance (one at a time) code. This means that the H-330/331 senses a change for every 1/200th of a revolution for the SDI-12 output, or a change for every 1/100th of a revolution for the quadrature output. The H-330/331 continuously maintains a digital count representing the current position of the shaft. The H-330/331 counts to ±32,768 steps.

During normal operation, the SDI-12 data recorder sends an address together with a command to the H-330/331 sensor. The H-330/331 wakes up from its low power sleep mode, converts the shaft position into Feet, Meters or other units you the user have programmed for the stage measurement and stores this data in its data buffer. Once the data is ready, the data recorder collects the data from the H-330/331's data buffer.

1.3 Programming the Data Recorder

You must prepare your data recorder to receive and record the H-330/331 data. Since data recorders differ widely, refer to your recorder manufacturer's directions. The H-330/331 maintains two values or "parameters" of information about the shaft position: the **Scaled Shaft Position** in the selected engineering units and the **Absolute Shaft Position** in single unit steps. Using SDI-12, the data recorder can record both parameters or only one, this is up to the user. Usually only the first value is recorded. The data recorder must issue an "aM!" command, then collect the data with a "aD0" command, as explained in Chapter 2. The H-330/331 places two data values in its data buffer and the SDI-12 data that is returned to the data logger looks like this:

A+XX.XX+NNNN

Where:

A	= Is representative of the SDI-12 address 0-9, A-Z
+-XX.XX	= Current encoder position in user units of Feet, Meters etc.
+-NNNN	= Current absolute encoder position in units of steps (raw counts)

1.4 Programming the H-330/331

The H-330/331 comes from the factory with the following settings:

SDI Address: 0
Slope = 0.0050
Offset = 0.000

With these values the data will be in units of feet when used with a pulley having a circumference of 12 inches. The slope value can be changed to accommodate other pulley circumferences or to change the data to other engineering units such as inches or Meters. The Address, Slope and Offset setup is stored in EEPROM within the H-330/331 and will not be lost if the power is disconnected. The extended commands for changing the slope, offset and sensor address are described in detail in Chapter 2. If more than one sensor is to be connected to the SDI-12 bus, make certain each sensor has a different sensor address.

Many applications use a shaft encoder to monitor water in a stilling well. A float and pulley translate the water level to rotation of the encoder's shaft. When the H-330/331 is installed, the encoder will be at a position determined by the current water level. When the H-330/331 is powered up it resets its internal position count to 0000. All subsequent measurements will be relative to this initial position. If a measurement in absolute units or stage is wanted, you will need to change the OFFSET value to match the current stage as measured by a staff gauge or other datum.

Incremental encoders such as a quadrature encoders, monitor CHANGES in shaft position. With an incremental encoder, if the power is lost the encoder reference or zero position is also lost. The position count is maintained in RAM (not EEPROM) within the H-330/331. Storing the position in non-volatile (EEPROM) memory would not protect from power loss because encoder position changes would be missed while the power was down anyway. The H-330/331 protects its position count with a software flag or "signature". If the power is removed momentarily the H-330/331 will resume operation using the current position count. If the power is lost long enough to destroy the signature, when the power is restored the H-330/331 resets the position count to 0000. To intentionally reset the H-330/331's position count, disconnect the power for 5 to 10 seconds.

A backup battery input is also provided to maintain shaft position during main power interruption or loss. Any shaft movements while main power is lost will still be recognized and when main power is restored the measured values will reflect the shaft changes while main power was lost. Without the backup battery the value would start again at 0.00 or the current offset value.

With the shaft pointing toward you, rotating the encoder shaft counter-clockwise produces an increasing (positive) shaft position value. If this is backwards from your needs, either program the slope with a negative value for SDI-12 applications, or exchange the two quadrature connections to the shaft encoder for quadrature applications.

1.5 Making Output Connections

The H-330/331 has both a SDI-12 and quadrature outputs. The H-330/331 is an SDI-12 V1.2 compliant sensor. It connects directly to any data recorder with SDI-12 capability. In addition, the H-330/331 provides a raw quadrature output for use with other data recorders having a quadrature input.

The power for the H-330/331 is supplied by the SDI-12 +12V input. Table 1 shows the proper connections. Refer to the wiring diagram printed on the H-330/331's product label for the connector pinout.

Table 1
Cable Connections

Pin	Wire	Name
1	Red	+12Volt DC
2	Black	Ground
3	Green	Ground
4	Yellow	SDI-12 Data
5	Orange	Quadrature Phase A
6	Brown	Quadrature Phase B
7	Blue	Battery Backup
8		N/C
9		N/C

1.6 Words of Caution

! Make certain the encoder's output does not go negative or more than +5.0 Volts.
! Make certain the ground and power pins are connected to the encoder.
! Keep the lead wires as short as possible.
! Use shielded cables in noisy environments.

Chapter 2
H-331 Display Unit Operation

2.1 Overview

The H-330/331 has the same functionality as the H-330/331 with the addition of a built in display and manual offset adjustment. The display will always show the last measured value. The display uses negligible power and is always visible. A "Lo-Bat" symbol will appear if the +12 volt power falls below approximately 7.2 volts. The offset adjustment is a rotary digital encoder and is accessed by removing the attached dust cover. The adjustment encoder has a screwdriver slot and is easily rotated with a screwdriver or other flat blade tool. Replace the dust cap whenever the adjustment is not being used.

2.2 Read Button Operation

The H-330/331 has a 'Read' button that when pressed will cause the unit to continuously make measurements and update the display. The plus or minus sign character will flash when the unit is making continuous measurements indicating the display is being updated even if the value is not changing. When the button is released the display will freeze with the last measured value displayed. Measurement requests from an attached SDI-12 data logger will also cause the display to update.

2.3 Using the Adjust Knob to Change Current Stage Value

While the 'Read' button is pressed the Adjust screw may be turned to increase or decrease the current stage value. Rotate the adjustment screw clock-wise to increment the value and counter-clock wise to decrement the value. Turning the Adjust screw slowly will change the hundredths digit while turning the screw fast changes the tenths digit. This allows one control to make both fine and course adjustments.

2.4 Using the Adjust Knob to Change SDI-12 Address

If the 'Read' button is held down while the H-330/331 is being powered up, the display will show the current SDI-12 address. The SDI-12 address may be changed using the Adjust screw. Turning the Adjust screw will change the address in the range of 0 to 9. When the Read button is released the new SDI-12 address is saved and the display switches to the normal stage readout. To change the SDI-12 address again, the power must be disconnected and the special power-up sequence repeated.

Chapter 3
SDI-12 Command and Response Protocol

3.1 SDI-12 Command and Response Protocol

This is a brief description of the Serial Digital Interface (SDI-12) Command and Response protocol used by the ***WATER*LOG®** Series Model H-330/331 sensor. Included is a description of the commands and data format supported by the H-330/331.

Refer to the document "A SERIAL DIGITAL INTERFACE STANDARD FOR HYDROLOGIC AND ENVIRONMENTAL SENSORS". Version 1.2 April 12, 1996 Coordinated by the SDI-12 Support Group, 135 East Center, Logan, Utah.

During normal communication, the data recorder sends an address together with a command to the H-330/331 sensor. The H-330/331 then replies with a "response". In the following descriptions, SDI-12 commands and responses are enclosed in quotes. The SDI-12 address and the command/response terminators are defined as follows:

"a" Is the sensor address. The following ASCII Characters are valid addresses: "0-9", "A-Z", "a-z", "*", "?". Sensors will be initially programmed at the factory with the address of "0" for use in single sensor systems. Addresses "1 to 9" and "A to Z" or "a to z" can be used for additional sensors connected to the same SDI-12 bus. Address "*" and "?" are "wild card" addresses which select any sensor, regardless of its actual address.

"!" Is the last character of a command block.

"<cr><lf>" Are carriage return (0D) hex and line feed (0A) hex characters. They are the last two characters of a response block.

Notes:

- All commands/responses are upper-case printable ASCII characters.
- Commands must be terminated with a "!" character.
- Responses are terminated with <cr><lf> characters.
- The command string must be transmitted in a contiguous block with no gaps of more than 1.66 milliseconds between characters.

3.2 Measure Command

The Measure Command causes a measurement sequence to be performed. Data values generated in response to this command are stored in the sensor's buffer for subsequent collection using "D" commands. The data will be retained in the sensor until another "M", "C" or "V" command is executed.

Command	Response	Description
"aM!"	"atttn<cr><lf>"	Initiate measurement

Where:

a	is the sensor address ("0-9", "A-Z", "a-z", "*", "?").
M	is an upper-case ASCII character
ttt	is a three digit integer (000-999) specifying the maximum time, in seconds, the sensor will take to complete the command and have measurement data available in its buffer.
n	is a single digit integer (0-9) specifying the number of values that will be placed in the data buffer. If "n" is zero (0), no data will be available using subsequent "D" commands.

Upon completion of the measurement, a service request "a<cr><lf>" is sent to the data recorder indicating the sensor data is ready. The data recorder may wake the sensor with a break and collect the data anytime after the service request is received or the specified processing time has elapsed.

Example of a H-330 "aM!" command:

Command	Response	Time	Values	Description
"aM!"	"a0012<cr><lf>"	1 sec	2	Return encoder position

Subsequent Command	Response
"aD0"	a+X.XX+NNNN<cr><lf>

Where:
X.XX = Current position (stage), in user programmable units
NNNN = Current position (stage), in raw position counts

3.3 Concurrent Measurement Command

This is a new command for the Version 1.2 SDI-12 Specification. A concurrent measurement is one which occurs while other SDI-12 sensors on the bus are also taking measurements. This command is similar to the “aM!” command, however, the nn field has an extra digit and the sensor does not issue a service request when it has completed the measurement. Communicating with other sensors will NOT abort a concurrent measurement. Data values generated in response to this command are stored in the sensor's buffer for subsequent collection using "D" commands. The data will be retained in the sensor until another "M", “C” or "V" command is executed.

Command	Response	Description
"aC!"	"atttnn<cr><lf>"	Initiate measurement

Where:

a	is the sensor address ("0-9", "A-Z", "a-z", "*", "?").
C	is an upper-case ASCII character
ttt	is a three digit integer (000-999) specifying the maximum time, in seconds, the sensor will take to complete the command and have measurement data available in its buffer.
nn	is a two digit integer (00-99) specifying the number of values that will be placed in the data buffer. If "n" is zero (0), no data will be available using subsequent "D" commands.

The data recorder may wake the sensor with a break and collect the data anytime after the specified processing time has elapsed.

3.4 Send Data Command

The Send Data command returns sensor data generated as the result of previous "aM!", “aC!” or "aV!" commands. Values returned will be sent in 33 characters or less. The sensor's data buffer will not be altered by this command.

Command	Response
"aD0!" through "aD9!"	"apd.d ... pd.d<cr><lf>"

Where:

a	is the sensor address ("0-9", "A-Z", "a-z", "*", "?").
D0..D9	are upper-case ASCII characters.
p	Is a polarity sign (+ or -)
d.d	represents numeric digits before and/or after the decimal. A decimal may be used in any position in the value after the polarity sign. If a decimal is not used, it will be assumed to be after the last digit. For example: +3.29 +23.5 -25.45 +300

If one or more values were specified and a "aD0!" returns no data (a<CR><LF> only), it means that the measurement was aborted and a new "M" command must be sent.

The following is an example of the "aD0!" command.

Example of a H-330 "aD0!" command:

Previous command	Response
"aM!"	"a0012<cr><lf>"

Subsequent Command	Response
"aD0"	+X.XX+NNNN<cr><lf>

Where:
X.XX = Current position (stage), in user programmable units
NNNN = Current position (raw counts), in raw position counts

3.5 Continuous Measurements

This is a new command for the Version 1.2 SDI-12 Specification. Sensors that are able to continuously monitor the phenomena to be measured, such as a shaft encoder, do not require a start measurement command. They can be read directly with the R commands (R0!...R9!). The R commands work exactly like the D (D0!...D9!) commands. The only difference is that the R commands do not need to be preceded with an M command.

The H-330/331 supports the aR0! continuous measurement command.

Example of a H-330 "aR0!" command:

Command	Response
"aR0!"	"a+X.XX+NNNN<cr><lf>

Where:
X.XX = Current position (stage), in user programmable units
NNNN = Current position (raw counts), in raw position counts

3.6 Initiate Verify Command

The Verify Command causes a verify sequence to be performed. The result of this command is similar to the "aM!" command except that the values generated are fixed test data and the results of diagnostic checksum tests. The data generated in response to this command is placed in the sensor's buffer for subsequent collection using "D" commands. The data will be retained in the sensor until another “M”, “C” or “V” command is executed.

Command	Response	Description
"aV!"	"atttn<cr><lf>"	Initiate verify sequence

Where:

a	is the sensor address ("0-9", "A-Z", "a-z", "*", "?").
V	is an upper-case ASCII character.
ttt	is a three digit integer (000-999) specifying the maximum time, in seconds, the sensor will take to complete the command and have data available in its buffer.

n is a single digit integer (0-9) specifying the number of values that will be placed in the data buffer. If "n" is zero (0), no data will be available using subsequent "D" commands

Example of a H-330 "aV!" command:

Command	Response	Time	Values	Description
"aV!"	"a0013<cr><lf>"	1 sec	3	Return fixed data and diagnostic data for testing purposes.

Subsequent Command	Response
"aD0"	a+123.456+78.9+y<cr><lf>

Key	Description	Units
+123.456	Fixed test data	
+78.9	Fixed test data	
y	ROM checksum test	0 = Failed, 1 = Passed

3.7 Send Acknowledge Command

The Send Acknowledge Command returns a simple status response which includes the address of the sensor. Any measurement data in the sensor's buffer is not disturbed.

Command	Response
"a!"	"a<cr><lf>"

Where:

a Is the sensor address ("0-9", "A-Z", "a-z", "*", "?").

3.8 Send Identification Command

The Send Identification command responds with sensor vendor, model, and version data. Any measurement data in the sensor's buffer is not disturbed.

Command	Response
"aI!"	"allcccccccmmmmmmvvvxx...xx<cr><lf>"

Where:

a	is the sensor address ("0-9", "A-Z", "a-z", "*", "?").
I	is an upper-case ASCII character.
ll	is the SDI-12 version compatibility level, e.g. version 1.2 is represented as "12".
cccccccc	is an 8 character vendor identification to be specified by the vendor and usually in the form of a company name or its abbreviation.
mmmmmm	is a 6 character field specifying the sensor model number.
vvv	is a 3 character field specifying the sensor version number.
xx...xx	is an optional field of up to a maximum of 13 characters to be used for serial number or other specific sensor information not relevant to operation of the data recorder.

Example of a H-330 "aI!" command:

"a12 DAA H-330vvvS#nnnnnnVkkk<cr><lf>"

H-330 implementation of the optional 13 character field:
S#nnnnnnVkkk (12 bytes total)

Where:

"nnnnnn"	is a six character sensor serial number
"kkk"	is a three digit sensor firmware revision level

3.9 Change Sensor Address

The Change Sensor Address Command allows the sensor address to be changed. The address is stored in non-volatile EEPROM within the sensor. The H-330/331 will not respond if the command was invalid, the address was out of range, or the EEPROM programming operation failed.

Command	Response	Description
"aAn!"	"n<cr><lf>"	Change sensor address

Where:

a — is the current (old) sensor address ("0-9", "A-Z", "a-z", "*", "?"). An ASCII "*" may be used as a "wild card" address if the current address is unknown and only one sensor is connected to the bus.

A — is an upper-case ASCII character.

n — is the new sensor address to be programmed ("0-9", "A-Z", "a-z", "*", "?").

NOTE: To verify the new address use the "Identify Command."

Example of a "Change Sensor Address" command:

Command	Response	Description
"aA2!"	"2<cr><lf>"	Change sensor address to "2"

3.10 Zero the Position Command

The “Zero Position” command resets the encoder position counter internal to the H-330/331.

When the H-330/331 is first powered up the position count is automatically reset to zero. If the H-330/331 is built into a H-510 shaft encoder system, the backup battery in the H-510 maintains the position count and encoder circuitry even if the SDI-12 power is lost. After the battery is connected, the Zero Position command provides a means to reset the position counter.

In most applications the initial position count will be at some undeterminate value due to moving the encoder or adjustment of the float cables. Before programming the offset term (b) of the mX+b data scaling equation it is important to zero the current position count. This preserves the maximum dynamic range of the H-330/331's 16-bit position counter. After the position counter is zeroed, program the mX+b equation to obtain the desired stage using the extended write offset command (“aXWO”.)

Command	Response	Description
"aXZ!"	"a<cr><lf>"	Zero the position counter

Where:

a	is the sensor address ("0-9", "A-Z", "a-z", "*", "?").
XZ	are upper case characters

This command takes 000 seconds to complete and places no data in the data buffer.

Example of a H-330 Extended "Zero the Position" command:

Command	Response	Description
"aXZ!"	"a<cr><lf>”	Reset encoder position

3.11 Read User Offset and Read User Slope Commands

The H-330/331 processes the raw shaft encoder position with a mX+b equation. The slope (m) and offset (b) terms are programmable, allowing the user to scale the position into other engineering units. These commands allow the user to read the current slope and offset terms.

The slope is set to 0.005 and the offset to 0.000 at the factory. The H-330/331 has a mechanical position resolution of 200 counts per revolution. When used with a pulley 1.0 feet in circumference: 0.005feet/count x 200 counts/rev. = 1.0 feet/rev. The slope term can be changed for other pulley diameters or for other units such as inches or meters.

Command	Response	Description
"aXRS!"	"a0011<cr><lf>"	Read Slope
"aXRO!"	"a0011<cr><lf>"	Read Offset

Where:

a	is the sensor address ("0-9", "A-Z", "a-z", "*", "?").
XRS	are upper case characters.
XRO	are upper case characters.

This command takes 001 seconds to complete and places 1 value in the data buffer. Use the “aD0" command to collect and view the slope or offset.

Example of a H-330 Extended "Read User Units Slope" command:

Command	Response	Time	Values	Description
"aXRS!"	"a0011<cr><lf>"	1 sec	1	Read Slope

Command	Response	Description
"aD0!"	"a+0.005<cr><lf>"	Slope Reading is 0.005

3.12 Write User Offset and Write User Slope commands

The H-330/331 processes the raw shaft encoder position with a mX+b equation. The slope (m) and offset (b) terms are programmable, allowing the user to scale the encoder position into other engineering units. This command allows the user to write (change) the slope and offset terms. The new value is stored in non-volatile EEPROM within the sensor. Once the new slope or offset value is written to the EEPROM, a copy is sent to the sensor data buffer for verification. This data can be viewed by using a subsequent "D" command. To verify the Slope or Offset any other time, use the "Read User Slope" or "Read User Offset" commands.

Command	Response	Description
"aXWSddd!"	"a0011<cr><lf>"	Write Slope
"aXWOddd!"	"a0011<cr><lf>"	Write Offset

Where:

a is the sensor address ("0-9", "A-Z", "a-z", "*", "?").

XWS are upper case characters.
XWO are upper case characters.

ddd is the new slope or offset value. The input format is very flexible. Some examples are shown below.

20.0
0.195
-500
5.93E-4

Example of a H-330 Extended "Write User Units Slope" command:

Command	Response	Time	Values	Description
"aXWS1.234!"	"a0011<cr><lf>"	1 sec	1	Write Slope

Command	Response	Description
"aD0!"	"a+1.234<cr><lf>"	Slope verified at 1.234

Appendix A
Specifications

General

Input:	Shaft Position
Outputs:	SDI-12 & 2-Wire Quadrature
Resolution (SDI):	200 counts/rev
Resolution (Quadrature):	100 counts/rev
Max rate:	15 rev/sec

Quadrature Output

Type:	Open Drain (Optional factory installed pull up resistor to 5.0 V)
Transient Protection:	5.0V Transguard

SDI-12 Output

Baud Rate:	1200
Protocol:	SDI-12, 7-bit even parity, 1 stop bit
Output Voltage Levels:	
minimum high level:	3.5 volts
maximum low level:	0.8 volts
maximum cable length:	250 ft.

Power Requirements

Voltage Input:	9.6 to 16.0 Volts DC
Current:	Less than 2.0mA 800µA typical

Environmental

Operating Temperature:	-40 to 60 °C
Storage Temperature:	-50 to 70 °C
Humidity:	0 to 100%

Mechanical

Bearing:	Double bearing with external seal and 1.12 in. separation
Starting Torque:	0.15 oz·in typical 0.50 oz·in max over temperature
Shaft:	5/16 in. compatible with Stevens, and Fisher and Porter pulleys and accessories.
Shaft Length:	2.00 in.
Shaft Clearance:	1.75 in.
Shaft Tread:	24 threads per in.
Thread Length:	0.75 in.
Material:	Anodized Aluminum
Size:	5 1/8 in. wide (main unit) 7 in. wide (base plate) 4 1/4 in. high 4 in. deep (not including shaft or connectors)

Connectors (2 ea, same connections)

H-330/331:	AMP 206486-1	(9-Pin male)
Cable:	AMP 206485-1	(9-Pin female)

(One cable provided with the H-330/331)

Warranty

***WATER*LOG®** H-330/331 is warranted against defects in materials and workmanship for one year from date of shipment.