

# **SDI-12 Encoder**

**INSTRUCTION 91196  
March 2000**



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# Safety and Equipment Protection

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## **WARNING!**

ELECTRICAL POWER CAN RESULT IN DEATH, PERSONAL INJURY OR CAN CAUSE DAMAGE TO EQUIPMENT.

If the instrument is driven by an external power source, disconnect the instrument from that power source before attempting any repairs.

## **WARNING!**

BATTERIES ARE DANGEROUS. IF HANDLED IMPROPERLY, THEY CAN RESULT IN DEATH, PERSONAL INJURY OR CAN CAUSE DAMAGE TO EQUIPMENT.

Batteries can be hazardous when misused, mishandled, or disposed of improperly. Batteries contain potential energy, even when partially discharged.

## **WARNING!**

ELECTRICAL SHOCK CAN RESULT IN DEATH OR PERSONAL INJURY.

Use extreme caution when handling cables, connectors, or terminals; they may yield hazardous currents if inadvertently brought into contact with conductive materials, including water and the human body.

## **CAUTION!**

Be aware of protective measures against environmentally caused electric current surges.

In addition to the previous warnings and cautions, the following safety activities should be carefully observed.

# Safety and Equipment Protection

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## Children, Adolescents

NEVER give batteries to young people who may not be aware of the hazards associated with batteries and their improper use or disposal.

## Jewelry, Watches, Metal Tags

To avoid severe burns, NEVER wear rings, necklaces, metal watch bands, bracelets, or metal identification tags near exposed battery terminals.

## Heat, Fire

NEVER dispose of batteries in fire or locate them in excessively heated spaces. Observe the temperature limit listed in the instrument specifications.

## Charging

NEVER charge “dry” cells or lithium batteries that are not designed to be charged.

NEVER charge rechargeable batteries at currents higher than recommended ratings.

NEVER recharge a frozen battery. Thaw it completely at room temperature before connecting charger.

## Unvented Container

NEVER store or charge batteries in a gas-tight container. Doing so may lead to pressure buildup and explosive concentrations of hydrogen.

## Short Circuits

NEVER short circuit batteries. High current flow may cause internal battery heating and/or explosion.

# Safety and Equipment Protection

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## Damaged Batteries

Personal injury may result from contact with hazardous materials from a damaged or open battery. NEVER attempt to open a battery enclosure. Wear appropriate protective clothing, and handle damaged batteries carefully.

## Disposal

ALWAYS dispose of batteries in a responsible manner. Observe all applicable federal, state, and local regulations for disposal of the specific type of battery involved.

## **NOTICE**

Stevens makes no claims as to the immunity of its equipment against lightning strikes, either direct or nearby.

The following statement is required by the Federal Communications Commission:

WARNING - This equipment generates, uses, and can radiate radio frequency energy and, if not installed in accordance with the instructions manual, may cause interference to radio communications. It has been tested and found to comply with the limits for a Class A computing device pursuant to Subpart J of Part 15 of FCC Rules, which are designed to provide reasonable protection against such interference when operated in a commercial environment. Operation of this equipment in a residential area is likely to cause interference in which case the user at his own expense will be required to take whatever measures may be required to correct the interference.

## **USER INFORMATION**

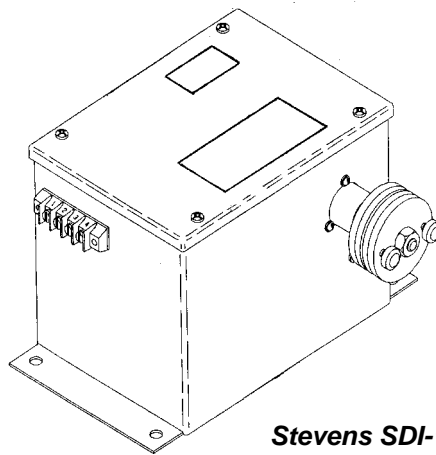
Stevens makes no warranty as to the information furnished in these instructions and the reader assumes all risk in the use thereof. No liability is assumed for damages resulting from the use of these instructions. We reserve the right to make changes to products and/or publications without prior notice.

# 1 Installation & Operation

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## *Stevens SDI-12 Encoder*

*With optional LCD readout and back-up battery voltmeter*



**Stevens SDI-12 Encoder**

### **1.1 GENERAL DESCRIPTION**

The Stevens SDI-12 Encoder (SDI ENCODER) is a float-operated level sensing device which provides an industry standard SDI-12 output for use together with appropriate data loggers and other equipment, providing a complete water level gaging system for long term remote applications. The SDI ENCODER (see *Figure 1*) was designed primarily as an input device for use with the AxSys MPU. However, having a standard SDI-12 output makes the SDI ENCODER usable as an input device for other equipment. In normal operation the SDI ENCODER obtains its power from the data logger or other device.

# 1 Installation & Operation

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An optional display can be used for device setup using two simple pushbuttons. The display can also be set to continuously output the current level reading. An optional backup battery can be installed, together with an optional voltmeter for backup battery checking.

## 1.2 ENCODER QUICK CHECK and SET UP

The following steps can be taken to achieve a “quick check and set up” of the Encoder.

- a. Remove the encoder from its packing material
- b. Remove the 4 screws on the top of the encoder. Connect up the backup battery.
- c. Apply 12 VDC to terminals 1 (+) and 2 (-) on the side of the encoder (see pg 7).
- d. Press either pushbutton 1 or pushbutton 2. The encoder display should come on. It will blank out again after about 15 seconds. Press either pushbutton again to bring it back on.
- e. Observe the change in display for rotation of the input shaft. If the direction of change needs to be reversed, move the direction switch on the lower pc board inside the encoder (see pg 6).
- f. Replace the lid and 4 screws on the top of the encoder.
- g. Connect the encoder to the desired logger or other instrument (see pg 7). Set the instrument for **ADDRESS 0** and **PARAMETER 2** for the appropriate SDI-12 channel. (Use **PARAMETER 1** for metric scaling).

# 1 Installation & Operation

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## 1.3 SDI ENCODER SPECIFICATIONS

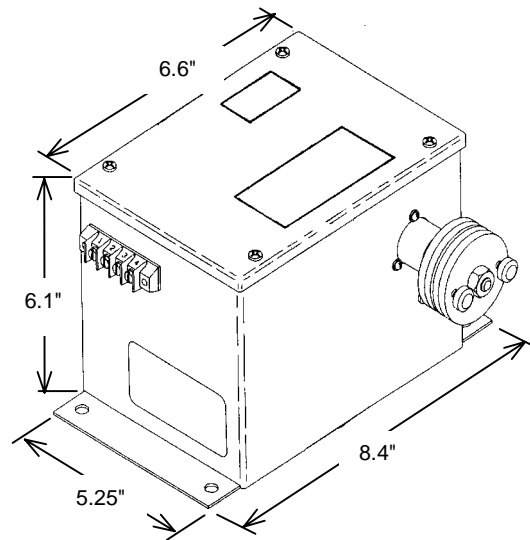
**Input:** Shaft and pulley clamp to accept standard Stevens 12 inch, 18 inch or 375 mm circumference float pulley.

**Output:** SDI-12 serial data communications.

**Range:** -999.99 to 999.99

**Torque:** .2 in-oz or less

**Accuracy:** +/- .01 ft (with 12" circumference pulley).



**Power requirements:** Nominal 12VDC (9-15 VDC) Supplied by connected Stevens instrument.

**Operating temperature:** -40 to +70 °C (-40 to 158 °F)

**Humidity:** To 95% relative, non-condensing. This can be improved by installing fresh desiccant inside the enclosure.

**Size:** 5.25 by 6.6 by 6.1 in (127 by 163 by 149 mm) exclusive of mounting flanges and input shaft.

**Weight:** 2.4 lb ( 1.1 kg).

# 1 Installation & Operation

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## 1.4 STANDARD (FACTORY) SETTINGS.

The SDI ENCODER comes factory set for immediate operation. One advantage of the SDI ENCODER is that both metric and English scales are available at all times. They are simply selected as different parameter outputs of the SDI-12 data string.

*Note: The English (feet) output is Parameter 2 (aD1! Command)  
The Metric (meters) output is Parameter 1 (aD0! Command)*

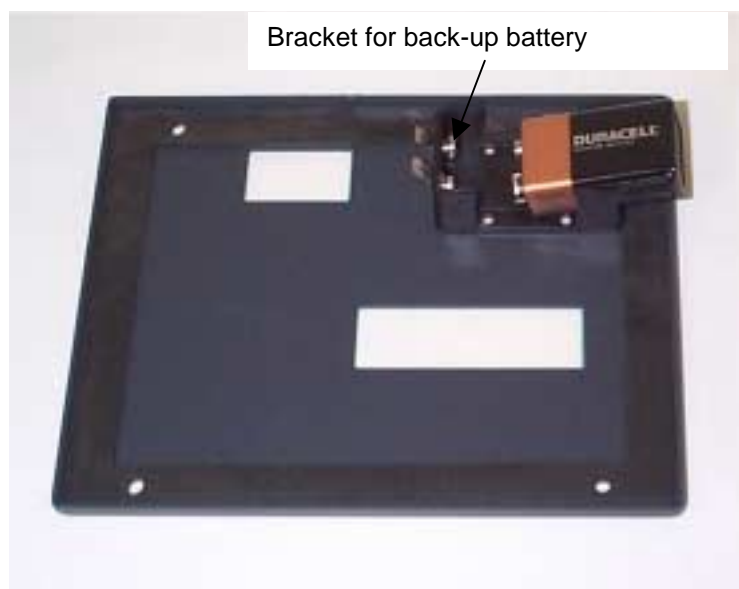
Default address is address 0. Additional information on the SDI-12 commands and output is available in Section 2.

## 1.5 BACK-UP BATTERY AND VOLTAGE READOUT

The encoder may be supplied with an optional internal back-up battery to maintain encoder tracking during failure of the SDI-12 power input. This is a 9 volt alkaline battery which can be easily obtained. It is installed in the lid of the unit. Simply remove the four screws holding the lid in place and remove the lid for access. The unit is shipped with the battery disconnected. Simply re-attach the single spade lug to the terminal on the battery holder (see below).

# 1 Installation & Operation

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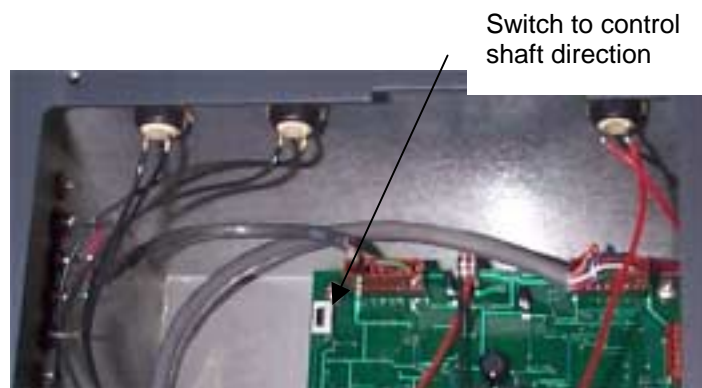
The back-up battery voltage can be read by pressing the pushbutton on the rear of the unit near the display (see pg 8). The battery should be replaced when the reading is below 8.00 volts.

# 1 Installation & Operation

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## 1.6 DIRECTION REVERSAL

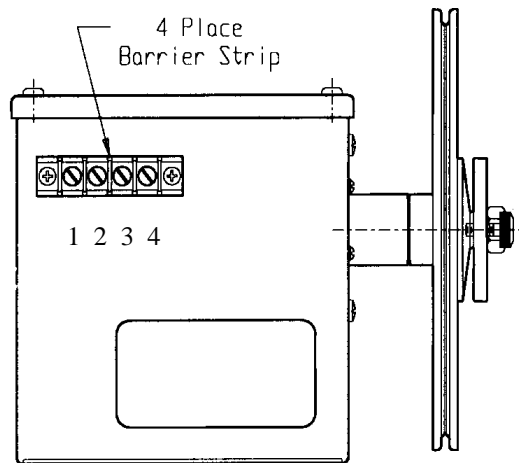
The unit has an internal switch which controls the encoder wheel direction for increasing readings. Factory default is for clockwise rotation to give increasing readings. Simply change the switch position to reverse the direction to counter-clockwise for increasing readings. The switch is located on the lower pc board (below the display board, if installed) and is accessed by removing the encoder lid as described in section 1.2 above. See photo, below, for actual switch location.



# 1 Installation & Operation

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## 1.7 STANDARD WIRING.



Signal and power wiring to the SDI ENCODER is achieved through the 4-place barrier strip at the side of the instrument.

Only the first 3 connections are used. Wiring is as follows:

1. Power (Red) (+12 VDC from receiving instrument)
2. Ground (Black)
3. Signal (Green)

Typical wiring for a Stevens AxSys input cable would use the above referenced wire colors.

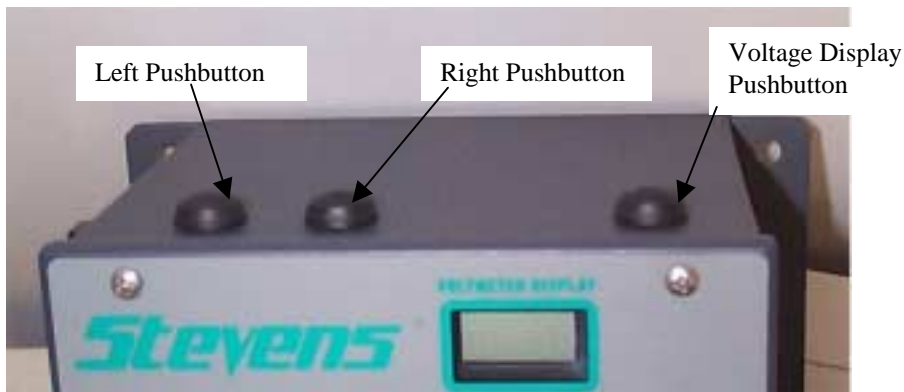
## 2 Options & Programming

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### 2.1 OPTIONAL DISPLAY INTERFACE.

The LCD display may be used as a display and programming set for the SDI-12 shaft encoder. Simply press either the left or right pushbutton to display the current encoder value for 15 seconds. For programming, pressing both buttons will act as ENTER or SELECT, pressing the left button will act as an ESC to abort the current menu selection, and pressing the right button will scroll through readings, The only exception to the left button ESC is when scrolling up and down through number entries. The way to escape out of this programming sequence is to have no activity for 5 seconds. The standard timeout when using the display as a programming set is 15 seconds.

### 2.2 LCD/PUSHBUTTON PROGRAMMING OF THE SDI ENCODER



## 2 Options & Programming

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To accomplish pushbutton programming of the SDI ENCODER, it is best if the SDI-12 bus is not active. Check that the AxSys is in sleep mode during this activity (Display is blank on AxSys). To enter the programming mode, press both programming switches simultaneously for approximately 2 seconds. The LCD should display the following.



This is the first menu item in the Encoder programming. ADJUST allows for setting of the current reading on the encoder. To enter this mode, press both pushbuttons simultaneously again for about 2 seconds. The display will change and show the current encoder reading. Use the right and left pushbuttons individually to increment (left) or decrement (right) the reading up or down to the desired value. Once the correct value is obtained, press and hold both pushbuttons until the following display appears:



This indicates the reading has been entered. Release the buttons and display will return to the main menu, and again display ADJUST. Press the right button to advance to the next menu item, or the left button to exit programming.

ADJUST	Sets the current reading up or down	-999.99 to 999.99	RIGHT Scroll up LEFT Scroll down BOTH Enter 5 sec Unchanged
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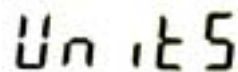
## 2 Options & Programming

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The image shows a close-up of an LCD display with the text "Addr 55" in a green, seven-segment font. The text is centered on the screen.

This is the second menu item in the Encoder programming. ADDRESS allows the user to set the SDI-12 Address to be used by the encoder. To enter this mode, press both pushbuttons simultaneously again for about 2 seconds. The display will change and show the current SDI-12 address. Use the right pushbutton to increment through the available addresses to the desired value. Once the correct value is obtained, press and hold both pushbuttons until the display shows GOOD as previously described. This indicates the reading has been entered. Release the buttons and display will return to the main menu, and again display ADJUST. Press the right button to advance to the next menu item, or the left button to exit programming.

ADDRESS	Select new SDI-12 address	0 through 9	RIGHT Scroll up LEFT Exit BOTH Enter
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The image shows a close-up of an LCD display with the text "Units" in a green, seven-segment font. The text is centered on the screen.

This is the next menu item in the Encoder programming. UNITS allows the user to set the LCD Display to show either English or Metric units. The Encoder is always tracking both English and Metric units, regardless of pulley size or desired

## 2 Options & Programming

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SDI-12 output. Consequently, at any time, the user can choose to display the current reading on the LCD display in either English (XXX.XX feet) or Metric (XXX.XX meters) units. To enter this mode, press both pushbuttons simultaneously again for about 2 seconds. The display will change and show the current units. Use the right pushbutton to toggle between **FEET** and **METERS**. Once the correct value is obtained, press and hold both pushbuttons until the display shows **GOOD** as previously described. This indicates the selected units have been entered. Release the buttons and display will return to the main menu, and again display **ADJUST**. Press the right button to advance to the next menu item, or the left button to exit programming.

UNITS	Sets the units to display the data on the Display	M display in meters F display in feet	RIGHT M or F LEFT Exit BOTH Enter
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**Aug**

This feature is not implemented and should be skipped over in the Encoder programming.

**Lcd**

This next item sets the mode of operation for the LCD display during normal encoder operation. The display can be set to be always ON, constantly displaying the encoder value; OFF to

## 2 Options & Programming

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allow for display only when one or the other of the pushbuttons is pressed, or SWITCH, which enables the display via an onboard switch on the internal PC board. To enter this mode, press both pushbuttons simultaneously again for about 2 seconds. The display will change and show the current display mode, either ON or OFF or SWITCH. OFF provides the lowest power operating mode (<1 mA operating current). ON will increase operating current by about 10 mA. In the OFF mode, pushing either button will cause the display to show the current reading, then go off and return to low power mode after about 15 seconds. Use the right pushbutton to move through the available modes to the desired mode. Once the correct mode is obtained, press and hold both pushbuttons until the display shows GOOD as previously described. This indicates the reading has been entered. Release the buttons and display will return to the main menu, and again display ADJUST. Press the right button to advance to the next menu item, or the left button to exit programming.

LCD	Set power mode by LCD usage, by switch selection, Always ON, or auto-off after 15 seconds	Switch ON OFF	RIGHT Selection LEFT Exit BOTH Enter
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## 2 Options & Programming

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ZERO

This menu item allows the user to quickly ZERO the encoder reading. To perform this action, simply press and hold both pushbuttons until the display shows GOOD as previously described. This indicates the reading has been set to zero. Release the buttons and display will return to the main menu, and again display ADJUST. Press the right button to advance to the next menu item, or the left button to exit programming.

ZERO	Zero Shaft Encoder	Clear	RIGHT Exit LEFT Exit BOTH Zero reading
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SCALE

This menu item sets the scaling for encoder counts per revolution. The standard value is 1.00, and assumes a 1 foot circumference pulley, which is standard for the encoder. The value can be incremented or decremented to the desired reading representing the attached pulley, or any desired scaling. Setting the SCALE to -1.00 will effectively reverse the direction of the scaling. To enter this mode, press both pushbuttons simultaneously again for about 2 seconds. The display will change and show the current SCALE. Use the right or left pushbuttons to increment (left) or decrement (right) the display

## 2 Options & Programming

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until the desired value is obtained. Once the correct value is obtained, press and hold both pushbuttons. The display will then show UNITS, either F or M. Select the proper units for the scaling as in the UNITS section described above. Press and hold both pushbuttons until the display shows GOOD as previously described. This indicates the reading has been entered. Release the buttons and display will return to the main menu, and again display ADJUST. Press the right button to advance to the next menu item, or the left button to exit programming.

SCALE	Set pulley wheel scale factor, first entering scale, then units	Set Scale -999.99 to 999.99	RIGHT Scroll up LEFT Scroll down BOTH Enter 5 sec Unchanged
		Set Units, M for meters F for feet	RIGHT Select LEFT Exit BOTH Enter

*Table of Scale Values for Different Pulley Sizes*

<b>Pulley Size</b>	<b>Scale Value</b>	<b>Parameter #</b>	<b>Readout</b>
12 inch	1.00	2	xxx.xx feet
18 inch	1.50	2	xxx.xx feet
36 inch	3.00	2	xxx.xx feet
375mm	1.23	1	xxx.xx meters
750mm	2.46	1	xxx.xx meters

## 2 Options & Programming

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EEPROM

This menu item is used to initialize the onboard EEPROM when a new software EPROM is installed in the encoder circuit board. This step should ONLY be done when a new EPROM is installed, or when the user wants to return the unit to original factory settings, and otherwise should be skipped. To initialize the EEPROM, Press and hold both pushbuttons while the display shows INIT and then GOOD. This will take about 4 seconds. The display should then return to ADJUST.

EEPROM	Set encoder EEPROM to factory defaults	INIT	RIGHT Exit LEFT Exit BOTH Set Defaults
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VER 1.06

The final menu entry indicates the software version number. This entry is read only, and cannot be changed. Refer to this reading for any factory inquiries regarding encoder operation.

VERSION	Display firmware version		RIGHT Exit LEFT Exit BOTH Exit
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## 2 Options & Programming

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### 2.3 SDI-12 SHAFT ENCODER LCD MENU OPTIONS SUMMARY

<u>OPTION</u>	<u>DESCRIPTION</u>	<u>SELECTION</u>	<u>KEY ACTIONS</u>
ADJUST	Sets the current reading up or down	-999.99 to 999.99	RIGHT Scroll up LEFT Scroll down BOTH Enter 5 sec Unchanged
ADDRESS	Select new SDI-12 address	0 through 9	RIGHT Scroll up LEFT Exit BOTH Enter
UNITS	Sets the units to display the data on the Display	M display in meters F display in feet	RIGHT M or F LEFT Exit BOTH Enter
AVERAGE	Not Implemented		
LCD	Set power mode by LCD usage, by switch selection, Always ON, or auto-off after 15 seconds	Switch ON OFF	RIGHT Selection LEFT Exit BOTH Enter
ZERO	Zero Shaft Encoder	Clear	RIGHT Exit LEFT Exit BOTH Zero reading
SCALE	Set pulley wheel scale factor, first entering scale, then units	Set Scale -999.99 to 999.99	RIGHT Scroll up LEFT Scroll down BOTH Enter 5 sec Unchanged
		Set Units, M for meters F for feet	RIGHT Select LEFT Exit BOTH Enter

## 2 Options & Programming

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<u>OPTION</u>	<u>DESCRIPTION</u>	<u>SELECTION</u>	<u>KEY ACTIONS</u>
EEPROM	Set encoder EEPROM to factory defaults	INIT	RIGHT Exit LEFT Exit BOTH Set Defaults
VERSION	Display firmware version		RIGHT Exit LEFT Exit BOTH Exit

### 2.4 Stevens SDI-12 Shaft Encoder Command Summary

#### 2.4.1 Standard Command Set

<u>COMMAND</u>	<u>MEANING</u>	<u>RESPONSE</u>	<u>MEANING</u>
a!	Acknowledge active	a	Sensor active
aI!	Request identity	010 Stevens bbbb	Sensor sends its ID code
aM!	Start measurements	add5	Sensor will have 5 measurements in ddd seconds
aD0!	Retrieve par. 1	asfff.ff	Level in meters
aD1!	Retrieve par. 2	asfff.ff	Level in feet
aD2!	Retrieve par. 3	axxxx	Raw counts
aD3!	Retrieve par. 4	axxxx	Up counter value
aD4!	Retrieve par. 5	axxxx	Down counter value
aV!	Verify sensor setup	addd6	Six setup parameters available in ddd seconds
aD0!	Setup par. 1	addd	# of samples
aD1!	Setup par. 2	aV	LCD units, F or M
aD2!	Setup par. 3	asfff.ff	Signed offset value
aD3!	Setup par. 4	aV	Offset units, F or M
aD4!	Setup par. 5	asfff.ff	Signed count/rev
aD5!	Setup par. 6	aV	Units per rev, F or M

#### 2.4.2 Extended Command Set

## 2 Options & Programming

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<u>COMMAND</u>	<u>MEANING</u>	<u>RESPONSE</u>	<u>MEANING</u>
aXAb!	Change sensor address to address b	NEW ADDRESS: b	Address successfully reprogrammed
aXCfff.fff!	Set sensor current Reading with sign to fff.ff in Feet	LEVEL: sfff.ff Feet	Unit offset is set to sfff.ff Feet, counters reset
aXDbbbbbb!	Edit Sensor ID field, up to 12 alpha numeric characters	NEW ID: bbbbbbb	Sensor echoes new ID field
aXI!	Initialize onboard counters to zero	COUNTERS INITIALIZED	Up and Down counters read zero
aXSfff.fff!	Change sensor scale to sfff.ff feet per revolution with sign s	NEW SCALE: sfff.fff	One wheel revolution equals sfff.ff Feet
aXSfff.fffM!	Change sensor scale to sfff.ff meters per revolution with sign s	NEW SCALE: sfff.fffM	One wheel revolution equals sfff.ff Meters
aXUF!	Change Display units to feet	DISPLAY UNITS: F	The LCD Display will show level units in Feet
aXUM!	Change Display units to meters	DISPLAY UNITS: M	The LCD Display will show level units in Meters