HydroLynx Systems, Inc.

Model 50386SE-105
SDI-12 Shaft Encoder

Instruction Manual

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Equipment Configuration and Parts Identification

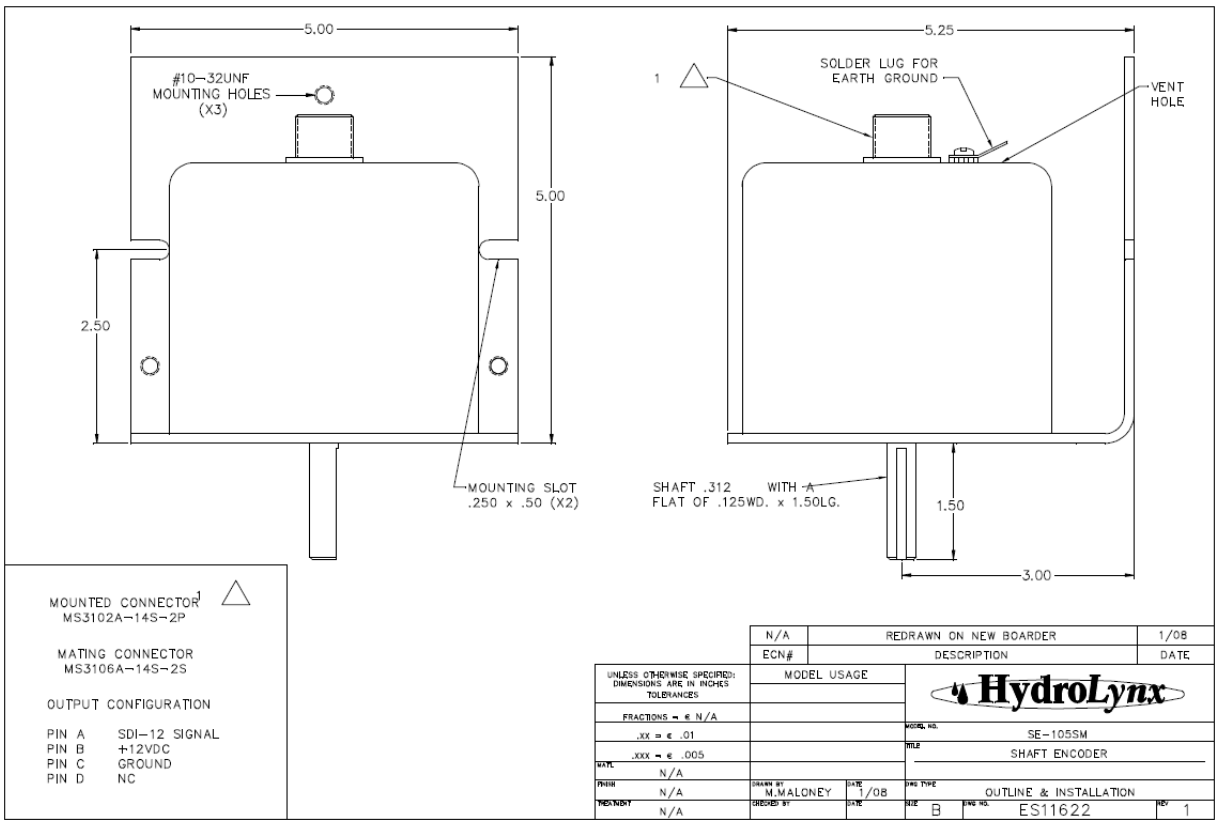


Figure 1: 50386SE-105 Standard Configuration

1 INTRODUCTION

1.1 General Description

The Model 50386SE-105 SDI-12 Shaft Encoder is a low power shaft encoder designed for battery powered field operation for the measurement of water level or floodgate position. The internal microprocessor allows the encoder to emulate an absolute encoder. The user may set the initial water level, read and adjust subsequent levels through the SDI-12 interface. The encoder operates with standard float tape or bead chain pulleys and float hardware.

1.2 Equipment Included

1> 50386SE-105
2> Cable Connector

1.3 Specifications

Power	10 to 16Vdc, reverse polarity protected.
Power Dissipation	<2.0mA at 13.6Vdc, 28mW standby, 5mA at 13.6Vdc 68mW

during communication only.

Full Scale — Full scale is limited to 7 digits plus 2 for the decimal and sign. Full scale is -99999.99 to +99999.99 or -9999.999 to +9999.999. The starting number after power on reset is set to 0.

Scaling — Scaling is determined by a user entered value. The scaling value determines the increment for each count of the shaft rotation. For positive scaling values, the output count increases for clockwise rotation. For negative scaling values, the output count decreased for clockwise rotation.

Counts per Turn — The Shaft Encoder may be user programmed for 100 or 400 counts per revolution.

Resolution — The Shaft Encoder may be use programmed for output resolution of 0.01 or 0.001.

Serial Communications — 1200 baud, 7 data bits, even parity, 1 stop bit using standard ASCII character set. All communications recognize an address which is set by an internal switch. The serial output is tri-stated during inactivity to allow for single wire half-duplex operation. Conforms to SDI-12 version 1.2 Specification.

2 INSTALLATION

The 50386SE-105 Shaft Encoder uses optical couplers with a slotted disc to measure rotation and may be mounted in any position. The unit requires a pulley but does not require the hub assembly used on earlier assemblies as the count value can be changed with a PC computer or through the recording instrument interface. The mounting bracket provides tapped holes for leveling screws. Figure 1 shows the 50386SE-105 outline and the mounting holes.

2.1 Connection to Shaft Encoder

The Shaft Encoder has the following SDI-12 connection.

Standard 4-pin SDI-12 Interface Connector	
Connector Type: MS3102A-14S-2P	
Matting Connector: MS3106R-14S-2S	
Pin	Function
A	SDI-12 Signal
B	+12VDC
C	Ground
D	No Connection

2.2 Operation

The standard Shaft Encoder operates with the SDI-12 protocol version 1.2. This protocol defines a hardware and software interface where data is transmitted and received over a single data wire.

2.3 SDI-12 Commands

The following describes the operation of the commands available through the interface. The 'a' in the following commands is the single character address.

2.3.1 Initiate Measurement

aM! Initiate a measurement. The Shaft Encoder returns a0001<CR><LF> indicating there is 1 measurement is available and it is available immediately. The data may be retrieved using the return measurement command. **aM1!** through **aM9!** return a0000<CR><LF>.

2.3.2 Return Measurement or Verify Data

aD0! Returns the data from an initiate measurement or verify data command. The returned data has the form shown below. The Shaft Encoder does not respond to **aD1!** through **aD9!**.

```
a+16.34<CR><LF>
||     ||       |
||     |+------+-->  Trailing CR LF
|+----+---------->  Data, + or - is data partition
+---------------->  Address
```

2.3.3 Initiate Verify

aV! Initiate verify command performs a series of diagnostic tests including battery test, ram test, prom and eeprom checksum values. The Shaft Encoder returns a0057<CR><LF> indicating there are 7 measurements available and they will be ready in 5 seconds. The Encoder sends service (a<CR><LF>) request when the data is ready. A typical return code is shown below.

```
a+0+0+0+0+0+0+13.5<CR><LF>
| | | | | | |   |
| | | | | | |   +-->  Input Power Voltage
| | | | | | |  +----->  Counter Value Checksum
| | | | | | |            0 Checksum is OK
| | | | | | |            1 Checksum is bad
| | | | | |  +-------->  EEPROM Checksum
| | | | | |              0 Checksum is OK
| | | | | |              1 Checksum is bad
| | | |  +---------->  PROM Checksum
| | | |                0 Checksum is OK
```

```
| | | |                  1 Checksum is bad
| | | +------------> RAM Test
| | |                  0 Ram tested OK
| | |                  1 Ram did not pass test
| | +--------->  Reset (Power up) information
| |              0 Shaft encoder not reset since last verify command
| |              1 Watch dog timer reset
| |              2 Loss of power reset
| |              3 Both loss of power and watch dog timer reset
| |              4 Reset caused by internal reset pin
| |              5 Reset caused by illegal op code execution
| |              6 Reset caused by internal oscillator problem
| |              7 Reset caused by low voltage to the microprocessor
| +----------> Always 0
+------------> Address
```

The second value indicates if the 50386SE-105 has been reset since the last Verify command.

0 No reset
1 Software reset (watchdog timer timed out)
2 Power on reset
3 Both resets occurred
4 Reset caused by the internal reset pin
5 Reset caused by the execution of an illegal op code
6 Reset caused by an internal oscillator problem
7 Reset caused by low voltage to the microprocessor

A reset may indicate the count data is not valid. An invalid count will be reset to the default count.

The third value indicates the results of a ram self test.

0 The ram test passed
1 The ram test failed

The forth value indicates the results of the prom self test.

0 The prom test passed (prom checksum is OK)
1 The prom test failed (prom checksum does not match the computed value)

The fifth value indicates the results of the EEPROM self test.

0 The EEPROM test passed (EEPROM checksum is OK)
1 The EEPROM test failed (EEPROM checksum does not match the computed value)

The sixth value indicates the condition of the count value. The count

value contains a checksum which is periodically tested. If the count value checksum is not valid, the default count value is loaded into the current count value. The default count value is contained in the EEPROM.

0 The count value checksum is OK
1 The count value has been reset to 0 because the count value checksum was invalid.

If the sixth value is set, it will be reset after the verify command has been issued.

The seventh value is the input power voltage in Vdc.

2.3.4 Send Identification

aI! Send identification command returns the 50386SE-105 identification string. The ID string is

```
a12HydroLynSE-1053.2-XXXXX<CR><LF>
||||       ||    || | |   |
|+|+------|+----|+-| +---+--> Serial number
| |        |     |  +--------> Version number
| |        |     +-----------> Model number
| |        +-----------------> Company ID
| +--------------------------> SDI-12 version number
+----------------------------> Address
```

2.3.5 Acknowledge Active

a! Acknowledge active. The Shaft Encoder responds with a<CR><LF>. The a<CR><LF> is the service request used the S and X commands.

2.3.6 Address Query Command

?! Address query command. The Shaft Encode responds with a<CR><LF> where a is the current set address 0-9, A-Z, or a-z. This command will cause every SDI-12 sensor to respond. If there is more than 1 sensor on the SDI-12 bus, then bus contention will occur and the returned data will be meaningless.

2.3.7 Set Address

aAb! Sets the Shaft Encoder address to the value in b. a is the current address and b is the new address. The Shaft Encoder responds b<CR><LF> if the new address was accepted or a<CR><LF> if the new address was not accepted.

2.3.8 Concurrent Measurement

aC! The Shaft Encoder returns a00001<CR><LF> indicating there is 1

measurement available and it is available immediately. The data may be retrieved using the return measurement command. **aC1!** through **aC9!** return a00000<CR><LF>.

2.3.9 Continuous Measurement

aR0! The continuous measurement command returns the current Shaft Encoder value and operates like the return measurement data command (**aD0!**) but does not require the preceding **aM!** command. **aR1!** through **aR9!** return a<CR><LF>.

2.3.10 Special Commands

The following special commands are used to scale and test the Shaft Encoder. These commands may not be supported by the Data Logger. All special commands have the following format.

aXnxxxx! n is the special function number and xxxx may be 1 or more data points. Each data point begins with a '+' or '-' sign. Some special functions may return data which may be accessed using the **aD0!** command.

aXn! Returns the data associated with the special command. The data is retrieved using the **aD0!** command. Not all special commands support the return data feature.

2.3.10.1 Set Current Value

aX0+123.45! The set current value special function sets the current Shaft Encoder value to the data attached to the command. For this example the current value is set to 123.45. The Shaft Encoder returns a<CR><LF> indicating it is ready to receive the next command.

2.3.10.2 Set Increment Value

Set the increment value and direction for each count. A positive Increment Value increments the Current Value when the pulley is rotated clockwise. A negative Increment Value increments the Current Value when the pulley is rotated counterclockwise.

Setting the Increment Value to a number larger than the Output Resolution precision (0.01 or 0.001), see Set Output Resolution command, **aX3!**, allows the Shaft Encoder value to increment in larger steps than the Output Resolution precision. For example, set the Output Resolution precision to 0.01 and the Increment Value to 0.05 to make the Shaft Encoder value increment by 0.05 for each count. If the value starts at 0.00, the first count increments the value to 0.05, the next count to 0.10, etc.

aX1! Read the Increment Value. The Shaft Encoder returns a0011<CR><LF> indicating the Shaft Encoder will have 1 parameter ready in 1 second. The data is retrieved using the **aD0!** command.

aX1+0.01! Set the Increment Value to 0.01. The current value will increment for clockwise pulley rotation. The Shaft Encoder returns a0011<CR><LF> indicating the Shaft Encoder will have 1 parameter ready in 1 second. The changed value may be verified by using the **aD0!** command. If an error is detected, the value returned by the **aD0!** command will be the original value.

aX1-0.0025! Set the Increment Value to -0.0025. The current value will increment for counter clockwise pulley rotation. The Shaft Encoder returns a0011<CR><LF> indicating the Shaft Encoder will have 1 parameter ready in 1 second. The changed value may be verified by using the **aD0!** command. If an error is detected, the value returned by the **aD0!** command will be the original value.

WARNING: Changing the Counts per Turn or Output Resolution automatically changes the Increment Value. Set these values first before setting the Increment Value.

2.3.10.3 Set Counts per Turn

The Counts per Turn sets the number of counts the Current Value is incremented for a complete revolution of the pulley. This value can be 100 or 400.

aX2! Read the Counts per Turn. The Shaft Encoder returns a0011<CR><LF> indicating the Shaft Encoder will have 1 parameter ready in 1 second. The data is retrieved using the **aD0!** command.

aX2+100! Set the Counts per Turn to 100. The Shaft Encoder returns a0011<CR><LF> indicating the Shaft Encoder will have 1 parameter ready in 1 second. The changed value may be verified by using the **aD0!** command. If an error is detected, the value returned by the **aD0!** command will be the original value.

aX2+400! Set the Counts per Turn to 400. The Shaft Encoder returns a0011<CR><LF> indicating the Shaft Encoder will have 1 parameter ready in 1 second. The changed value may be verified by using the **aD0!** command. If an error is detected, the value returned by the **aD0!** command will be the original value.

All other values are ignored.

WARNING: Changing the Counts per Turn automatically changes the Increment Value. Reset it with the Set Increment Value command, **aX1!**.

2.3.10.4 Set Output Resolution

The Output Resolution sets the number of digits to the right of the decimal point for the Current Value display precision. For example, an output resolution of 2 sets the Current

Value display precision to 0.01. An output resolution of 3 sets the Current Value display precision to 0.001.

aX3! Read the Output Resolution. The Shaft Encoder returns a0011<CR><LF> indicating the Shaft Encoder will have 1 parameter ready in 1 second. The data is retrieved using the **aD0!** command.

aX3+2! Set the Output Resolution to 2 digits. The Shaft Encoder returns a0011<CR><LF> indicating the Shaft Encoder will have 1 parameter ready in 1 second. The changed value may be verified by using the **aD0!** command. If an error is detected, the value returned by the **aD0!** command will be the original value.

aX3+3! Set the Output Resolution to 3 digits. The Shaft Encoder returns a0011<CR><LF> indicating the Shaft Encoder will have 1 parameter ready in 1 second. The changed value may be verified by using the **aD0!** command. If an error is detected, the value returned by the **aD0!** command will be the original value.

All other values are ignored.

WARNING: Changing the Output Resolution automatically changes the Increment Value. Reset it with the Set Increment Value command, **aX1!**.

2.3.10.5 Set ID Number

aX4! Read the Id Number. The Shaft Encoder returns a0011<CR><LF> indicating the Shaft Encoder will have 1 parameter ready in 1 second. The data is retrieved using the **aD0!** command.

aX4+12345! Set the Id Number to 12345. The Shaft Encoder returns a0011<CR><LF> indicating the Shaft Encoder will have 1 parameter ready in 1 second. The changed value may be verified by using the **aD0!** command. If an error is detected, the value returned by the **aD0!** command will be the original value. The ID number is readable using the Identify command. Acceptable values are 0 to 65535.

NOTE: The ID number is set to the PCB serial number by the factory.

2.3.10.6 Power On Reset

aX5! Power on reset. After receipt of this command the Shaft Encoder returns a<CR><LF> and performs a power on reset. The current count will not be changed. A power on reset activates battery charger commands.

2.3.10.7 Set Maximum Rotation Speed

The maximum rotation speed command sets the maximum shaft rotation speed from 0.5 rotations per second to 5 rotations per second. The value may be set in 0.5 rotations per

second increments. The current required to operate the Shaft Encoder is some what proportional to the rotation speed. This value is preset at the factory to 2.5 rotations per second. Input values of +.5, +1, +1.5, +2, +2.5, +3, +3.5, +4, +4.5 and +5 are acceptable. All other values are ignored.

aX7! Read the Maximum Rotation Speed. The Shaft Encoder returns a0011<CR><LF> indicating the Shaft Encoder will have 1 parameters ready in 1 second. The Shaft Encoder issues a service request when the current pulse options are available. The data is retrieved using the **aD0!** command.

aX7+2! Set the Maximum Rotation Speed to 2 rotations per second. The Shaft Encoder returns a0011<CR><LF> indicating the Shaft Encoder will have 1 parameter ready in 1 second. The changed value may be verified by using the **aD0!** command. If an error is detected, the value returned by the **aD0!** command will be the original value.

2.3.10.8 Set the Optocoupler Current

The Shaft Encoder contains 2 optocouplers to measure the position of the code disk. The 2 couplers are mechanically spaced so the output phasing is 90°apart. The current in the LED side of the couplers is adjusted so the output of the transistor side is a square wave when the shaft is rotated at a constant speed of 0.5 rotations per second. The first value sets the left coupler (ISO1) and the second changes the right coupler (ISO2). Valid values are 0 to 255.

aX13! Read the Optocoupler Current. The Shaft Encoder returns a0012<CR><LF> indicating the Shaft Encoder will have 2 parameters ready in 1 second. The data is retrieved using the **aD0!** command. The returned data is the left and right optocoupler current settings. For example:

```
a+59+57<CR><LF>
|   |   |
|   |   +---------------->  Right optocoupler current
|   +------------------->   Left optocoupler current
+----------------------->   Address
```

If an error is detected, the values returned by the **aD0!** command will be the original values.

aX13+61+63! Set the left Optocoupler Current to 61 and the right to 63. The Shaft Encoder returns a0012<CR><LF> indicating the Shaft Encoder will have 2 parameters ready in 1 second. The changed value may be verified by using the **aD0!** command. If an error is detected, the value returned by the **aD0!** command will be the original value.

NOTE: Save Optocoupler Current values to EEPROM with the **aX14!** command.

WARNING: Optocoupler current values are set by the factory. Do not change unless

you have the proper calibration equipment.

2.3.10.9 Save the Optocoupler Current to EEPROM

Setting the optocoupler current using the X13, X17, X18, X19, X20, or X21 commands, adjusts the current with the values saved in ram. This means if power is cycled the values will change to the ones stored to EEPROM. After the currents have been adjusted, they need to be saved to EEPROM using this command.

aX14! Save the Optocoupler Current to EEPROM. The Shaft Encoder returns a0012<CR><LF> indicating the Shaft Encoder will have 2 parameters ready in 1 second. The data is retrieved using the **aD0!** command. The returned data is the left and right current settings as read from the EEPROM.

2.3.10.10 Set the Input Voltage ADC Calibration

The Input Voltage ADC count is converted to voltage by the equation y =(***m***x/256+***b***)/10 equation, where ***m*** is the scale factor and ***b*** is the zero factor. The scale factor has a range of 0 to 255 and the zero factor has a range of +127 to -128. The conversion process is done using 8 bit integer arithmetic. Under normal conditions the ADC value is 0 for 0 Volts and 176 for 13.6 Volts. The scale factor ***m*** is set to 198 and the zero factor ***b*** is set to 0.

Y = (((198*170)/256)+0)/10
Y = ((34848/256)+0)/10
Y = (136 + 0)/10
Y = 13.6

aX15! Read the Input Voltage ADC Calibration. The Shaft Encoder returns a0031<CR><LF> indicating the Shaft Encoder will have 3 parameters ready in 1 second. The data is retrieved using the **aD0!** command. The returned data is the scale factor, the zero factor, and the computed voltage. For example:

```
a+198+0+13.0<CR><LF>
|   |   |   |
|   |   |   +------------>  Computed voltage
|   |   +----------------->  Zero factor b
|   +--------------------->  Scale factor m
+------------------------->  Address
```

aX15+198+1! Set the Input Voltage ADC Calibration scale factor ***m*** to 198 and zero factor ***b*** to 1. The Shaft Encoder returns a0031<CR><LF> indicating the Shaft Encoder will have 3 parameters ready in 1 second. The data is retrieved using the **aD0!** command. The returned data is the scale factor, the zero factor, and the computed voltage. For example:

```
a+198+1+13.1<CR><LF>
|   |   |   |
```

```
|   |   |   +------------>   Computed voltage
|   |   +---------------->   Zero factor b
|   +-------------------->   Scale factor m
+---------------------->   Address
```

If an error is detected, the values returned by the **aD0!** command will be the original values.

NOTE: Because of averaging in the Input Voltage calculations, the Input Voltage ADC Calibration may not show a change in the computed voltage until a second read request is made.

2.3.10.11 Increment Left Optocoupler Current

The left optocoupler (ISO1) current is incremented by one count. The value can not incremented above 255.

aX17! Increment the Left Optocoupler Current. The Shaft Encoder returns a0012<CR><LF> indicating the Shaft Encoder will have 2 parameters ready in 1 second. The data is retrieved using the **aD0!** command. The returned data is the left and right optocoupler current settings, see the Set Optocoupler Current command, **aX13!**.

NOTE: Save Optocoupler Current values to EEPROM with the **aX14!** command.

WARNING: This command is used by the factory to calibrate the Shaft Encoder. It requires the proper calibration equipment and is not recommended for field use.

2.3.10.12 Decrement Left Optocoupler Current

The left optocoupler (ISO1) current is decremented by one count. The value can not decremented below 0.

aX18! Decrement the Left Optocoupler Current. The Shaft Encoder returns a0012<CR><LF> indicating the Shaft Encoder will have 2 parameters ready in 1 second. The data is retrieved using the **aD0!** command. The returned data is the left and right optocoupler current settings, see the Set Optocoupler Current command, **aX13!**.

NOTE: Save Optocoupler Current values to EEPROM with the **aX14!** command.

WARNING: This command is used by the factory to calibrate the Shaft Encoder. It requires the proper calibration equipment and is not recommended for field use.

2.3.10.13 Increment Right Optocoupler Current

The right optocoupler (ISO2) current is incremented by one count. The value can not

incremented above 255.

aX19! Increment the Right Optocoupler Current. The Shaft Encoder returns a0012<CR><LF> indicating the Shaft Encoder will have 2 parameters ready in 1 second. The data is retrieved using the **aD0!** command. The returned data is the left and right optocoupler current settings, see the Set Optocoupler Current command, **aX13!**.

NOTE: Save Optocoupler Current values to EEPROM with the **aX14!** command.

WARNING: This command is used by the factory to calibrate the Shaft Encoder. It requires the proper calibration equipment and is not recommended for field use.

2.3.10.14 Decrement Right Optocoupler Current

The right optocoupler (ISO2) current is decremented by one count. The value can not decremented below 0.

aX20! Decrement the Right Optocoupler Current. The Shaft Encoder returns a0012<CR><LF> indicating the Shaft Encoder will have 2 parameters ready in 1 second. The data is retrieved using the **aD0!** command. The returned data is the left and right optocoupler current settings, see the Set Optocoupler Current command, **aX13!**.

NOTE: Save Optocoupler Current values to EEPROM with the **aX14!** command.

WARNING: This command is used by the factory to calibrate the Shaft Encoder. It requires the proper calibration equipment and is not recommended for field use.

2.3.10.15 Auto-calibrate Optocoupler Current

This command will set the initial values of the optocouplers. This is an automatic sequence and requires the board to be removed from the code disk and the optocouplers shielded from the ambient light source. Shielding the optocouplers with one's hand or turning the board so the optocouplers face the surface is all that is required.

aX21! Auto-calibrate the Optocoupler Current. The Shaft Encoder returns a0092<CR><LF> indicating the Shaft Encoder will have 2 parameters ready within 9 seconds. The data is retrieved using the **aD0!** command. The returned data is the left and right optocoupler current settings, see the Set Optocoupler Current command, **aX13!**.

NOTE: Save Optocoupler Current values to EEPROM with the **aX14!** command.

WARNING: This command is used by the factory to set initial optocoupler current values before the Shaft Encoder is calibrated. It should not be substituted

for a proper calibration with calibration equipment and is not recommended for field use.

2.3.10.16 Load Default Values

This command will load a set of default values into the EEPROM. The command is used at the factory during initial testing of the printed circuit board. The parameter data must be 31416

aX24+31416! Load Default Values. The EEPROM is erased and the default values loaded. The Shaft Encoder performs a power on reset when completed so no data is returned. The Shaft Encoder responds with a<CR><LF>.

WARNING: This command resets the optocoupler current values and requires a factory re-calibration of the Shaft Encoder.

2.3.10.17 Read Optocoupler Collector Voltage

This command displays the current value of the optocouplers in ADC counts ranging from 0 to 255. When LED is blocked the values will be above 224. When the LED is not blocked the value will be less than 32.

aX25! Read Optocoupler Collector Voltage. The Shaft Encoder returns a0012<CR><LF> indicating the Shaft Encoder will have 2 parameters ready in 1 second. The data is retrieved using the **aD0!** command. The command returns the left optocoupler value (ISO1), followed by the right optocoupler value (ISO2). For example:

```
a+13+14<CR><LF>
|   |   |
|   |   +---------------->  Right optocoupler collector voltage
|   +------------------->   Left optocoupler collector voltage
+----------------------->   Address
```

3 THEORY OF OPERATION

The Shaft Encoder contains 4 major function blocks consisting of power supply, microprocessor, optical sensors, and SDI interface. The operation of each section will be explained in the following paragraphs.

3.1 Power Supply

The power supply generates the operating voltages from the input power. Over-voltage and reverse voltage protection is provided by F1, D2, D3 and G3. R20 and R9 divide the voltage so it can be measured by the ADC in the microprocessor. Primary 3.3V is provided by switching regulator U2. +5V for the SDI interface is generated by linear regulator U8.

3.2 Microprocessor and Optical Sensors

The microprocessor's oscillator is derived from crystal Y1 and operates at 4.91MHz. This

frequency is used as it generates the 1200 baud oscillator for the SDI interface. The microprocessor contains the UART used for the SDI interface, an ADC, timers, SPI interface which connects to the EEPROM U1 and general purpose IO. The general purpose IO is used to interface with to generate the chip select to the EEPROM, control the SDI output buffer, and the optocouplers LED drive circuit.

The optocouplers are measured and controlled by the microprocessor. The power to the optocoupler LEDs is controlled by the microprocessor and are only turned on when a measurement is being made. The frequency is determined by the maximum shaft rotation speed and is computed as 400 times the rotation speed. So if the rotation speed is set to 2.5 rotations per second, then the optos are measured 1000 times per second. The current through the LED side of the optos is controlled by opamps U3 and U4. These amplifiers have enable inputs that are controlled by a timer inside the micro. When the opamps are enabled, the current is set by the voltage on pin 3. This voltage is determined by resistor dividers and the output of a PWM (pulse width modulator) inside the micro. After the LEDs have been on for a while, the voltage at the collectors of the optos are measured by the ADC located in the microprocessor. The value of this voltage determines if the shaft is rotating and the direction of rotation.

3.3 SDI Interface

The microprocessor operates from 3.3V and the SDI interface operates from 5V so the input and output to the UART must be level shifted. A comparator (U7) handles the SDI12 output. The bipolar output is tri-stated by the OUTON enable line on pin 5 of U7. The SDI12 input side goes through U6 and its output is diode isolated by D1 which provides the 5V to 3.3V level shift.

4 TESTING, CALIBRATION, AND MAINTENANCE

Once the 50386SE-105 is installed, proper operation is verified by reading levels with the SDI-12 Continuous Measurement command **aR0!**

4.1 Testing

The shaft encoder can only be tested with a DCU, DCP, data logger, or PC software program that can supports SDI-12 version 1.2 commands. The HydroLynx Systems 50386 Data Communication Unit (DCU) can be used to perform this testing. Use the SE105.sdi SDI-12 script file to simplify the testing.

4.1.1 Test Sensor Address

- Read the sensor SDI-12 address with the Address Query command **?!** and verify that your test program is set to the correct address.
- Set the sensor SDI-12 address with the Set Address command **aAb!**.

4.1.2 Test Output Resolution

- Read the Current Value with the SDI-12 Continuous Measurement command **aR0!**.
- Check the display precision. An Output Resolution of 2 displays two digits to the right of

the decimal point. An Output Resolution of 3 displays three digits to the right of the decimal point.
- Change the Output Resolution with the **aX3+2!** or **aX3+3!** command.

4.1.3 Test Counts per Revolution

- Read the Current Value with the SDI-12 Continuous Measurement command **aR0!**.
- Read the Increment Value with the SDI-12 **aX1!** command to determine the rotation direction for a positive increment. A positive Increment Value increments the Current Value when the pulley is rotated clockwise. A negative Increment Value increments the Current Value when the pulley is rotated counterclockwise.
- Read the Counts per Turn with the SDI-12 **aX2!** command to determine the number of increments for a full rotation of the pulley (100 or 400).
- Change the Counts per Turn with the **aX2+100!** or **aX2+400!** command.
- Rotate the pulley one complete turn in the positive increment direction (clockwise for positive Increment Value), read the Current Value and verify that the level has incremented by the Counts per Turn (100 or 400).
- Rotate the pulley one complete turn in the negative increment direction (counterclockwise for positive Increment Value), read the Current Value and verify that the level has decremented by the Counts per Turn (100 or 400).

4.1.4 Test Increment

- Read the Current Value with the SDI-12 Continuous Measurement command **aR0!**.
- Read the Increment Value with the SDI-12 **aX1!** command to determine the rotation direction for a positive increment. A positive Increment Value increments the Current Value when the pulley is rotated clockwise. A negative Increment Value increments the Current Value when the pulley is rotated counterclockwise.
- Set the Increment Value with the SDI-12 **aX1±.xxx!** command. A positive Increment Value increments the Current Value when the pulley is rotated clockwise. A negative Increment Value increments the Current Value when the pulley is rotated counterclockwise.
- Rotate the pulley in the positive increment direction (clockwise for positive Increment Value), read the level and verify that the level has incremented.
- Rotate the pulley in the negative increment direction (counterclockwise for positive Increment Value), read the level and verify that the level has decremented.

4.2 Calibration

- Set the Current value with the SDI-12 **aX0±x.xx!** command.
- Verify the Current value with the SDI-12 Continuous Measurement command **aR0!**.

4.3 Maintenance

The 50386SE-105 SDI-12 Shaft Encoder is essentially a maintenance free instrument; while the stilling well or servo manometer will require periodic maintenance. During this periodic maintenance HydroLynx recommends:

- Check to see that the 50386SE-105 is level.
- Check to see that all moving parts are free from obstruction.
- Verify the Current Value.

4.4 Troubleshooting

4.4.1 Visual Inspection

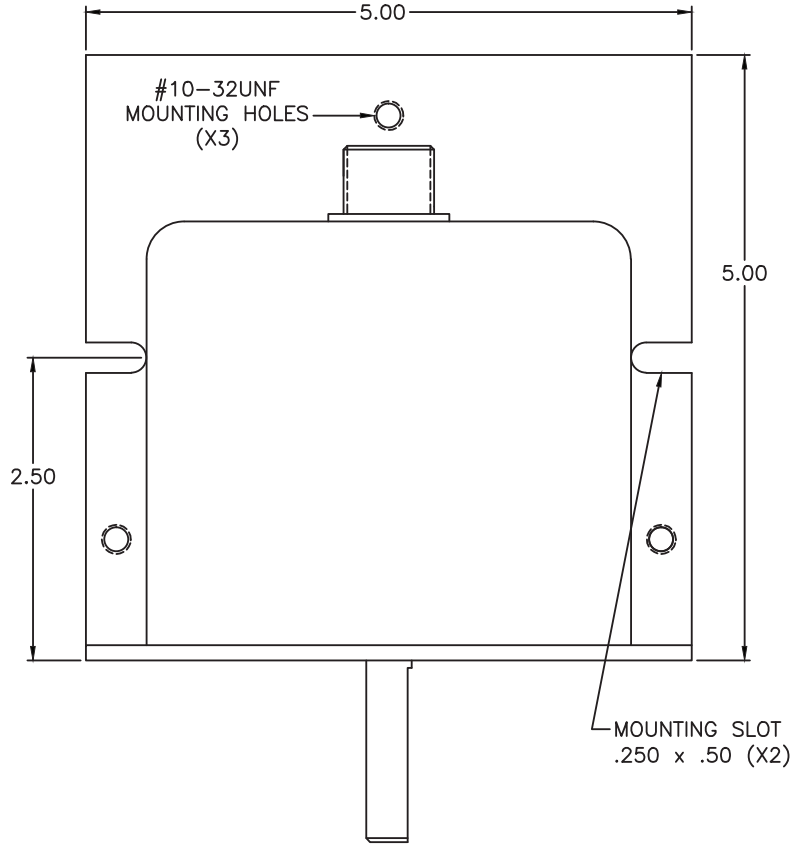
- Check the signal cable and connections.
- Check the float tape for binding.

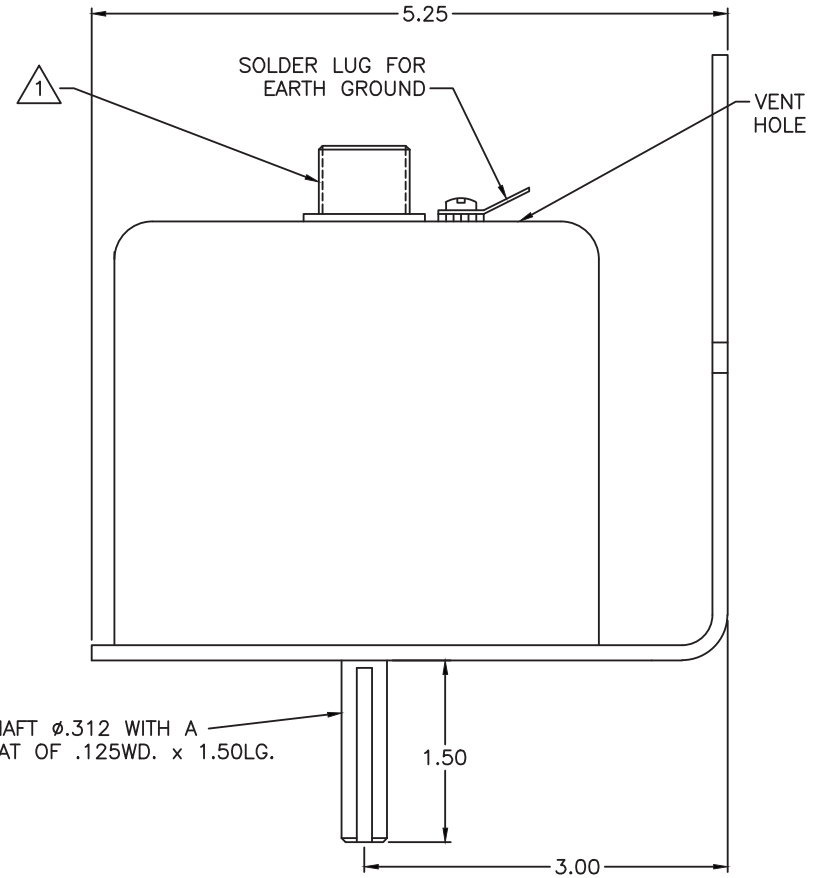
4.4.2 Testing

- Perform tests outlined in section 4.1
- No communication indicates a signal cable, connection, or PCB problem.
- Incorrect counts indicate a calibration problem of the optocouplers or PCB failure. Return the unit to the factory.

5 FORMS AND DRAWINGS

ES11622 SE-105 Outline and Installation
ES11661 Assembly, Cable, SDI-12, 4-pin
ES11709-1 Assembly, Cable, SDI-12, 3-pin





MOUNTED CONNECTOR
MS3102A–14S–2P

1

MATING CONNECTOR
MS3106A–14S–2S

OUTPUT CONFIGURATION

PIN A	SDI–12 SIGNAL
PIN B	+12VDC
PIN C	GROUND
PIN D	NC

ECN#	DESCRIPTION	DATE
N/A	REDRAWN ON NEW BOARDER	1/08

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES
TOLERANCES

FRACTIONS = ± N/A
.XX = ± .01
.XXX = ± .005

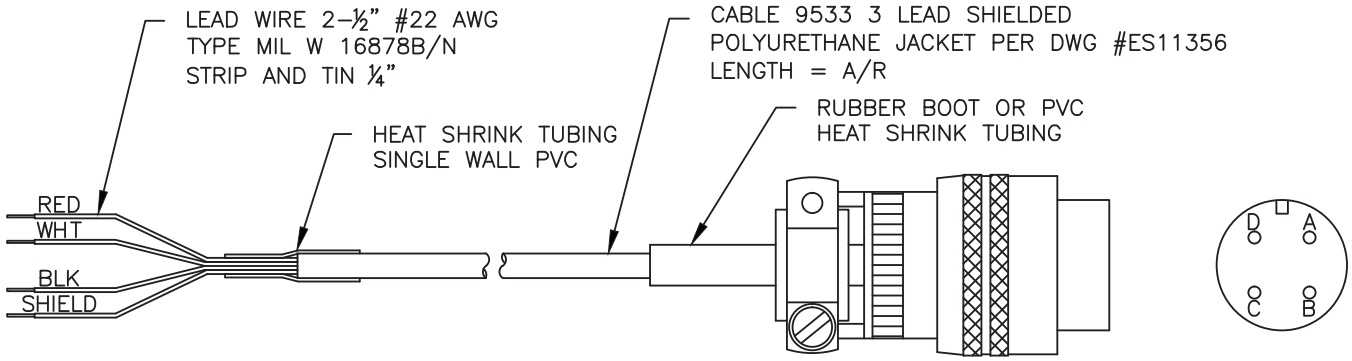
MAT'L: N/A
FINISH: N/A
TREATMENT: N/A

MODEL USAGE

DRAWN BY: M.MALONEY — DATE: 1/08
CHECKED BY — DATE

HydroLynx

MODEL NO.: SE–105SM
TITLE: SHAFT ENCODER
DWG TYPE: OUTLINE & INSTALLATION
SIZE: B — DWG NO.: ES11622 — REV: 1



LEAD WIRE CODE

RED = +12VDC
WHT = SDI–12 SIGNAL
BLK = POWER SIGNAL COMMON
SHIELD WIRE = CLEAR TUBING OVER BARE DRAIN WIRE

CABLE ASSEMBLY
MODEL CA–109M–XXX & CA–105

CONNECTOR
MS–3106A–14S–2S

BACK VIEW

A = SDI–12 SIGNAL (WHT)
B = +12VDC (RED)
C = GROUND (BLK)
D = NC

ECN#	DESCRIPTION	DATE

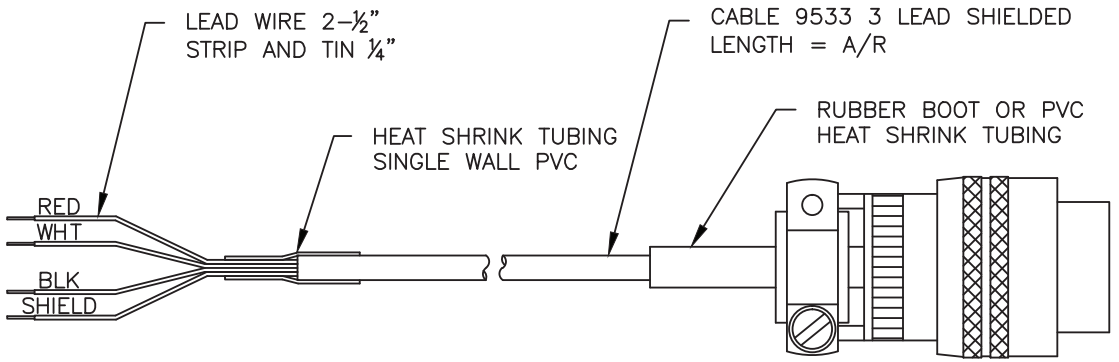
MODEL USAGE

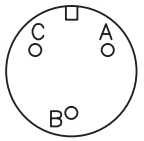
HydroLynx

MODEL NO. SE–105 & SE–109

TITLE CABLE, SDI

DRAWN BY	DATE	DWG TYPE		
MMALONEY	1/08	ASSY		
CHECKED BY	DATE	SIZE	DWG NO.	REV
		A	ES11661	





LEAD WIRE CODE

RED = +12VDC
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SHIELD WIRE = CLEAR TUBING OVER BARE DRAIN WIRE

CABLE ASSEMBLY
MODEL CA–109M–XXX & CA–105

CONNECTOR
MS–3106A–14S–2S

BACK VIEW

A = +12VDC (RED)
B = SDI–12 SIGNAL (WHT)
C = GROUND (BLK)

ECN#	DESCRIPTION	DATE
1	CHANGED MS PIN OUTPUT (C TO A) & (A TO C)	12/8/08

MODEL USAGE		HydroLynx	
		MODEL NO.	SE–105 & SE–109
		TITLE	CABLE, SDI W/ MINI 3–PIN MS CONNECTOR
DRAWN BY: MMALONEY	DATE: 4/08	DWG TYPE	ASSY
CHECKED BY	DATE	SIZE: A	DWG NO.: ES11709 / REV: 1