CS410 SHAFT ENCODER
INSTRUCTION MANUAL

REVISION: 2/03

Warranty and Assistance

The **CS410 SHAFT ENCODER** is warranted by CAMPBELL SCIENTIFIC, INC. to be free from defects in materials and workmanship under normal use and service for twelve (12) months from date of shipment unless specified otherwise. Batteries have no warranty. CAMPBELL SCIENTIFIC, INC.'s obligation under this warranty is limited to repairing or replacing (at CAMPBELL SCIENTIFIC, INC.'s option) defective products. The customer shall assume all costs of removing, reinstalling, and shipping defective products to CAMPBELL SCIENTIFIC, INC. CAMPBELL SCIENTIFIC, INC. will return such products by surface carrier prepaid. This warranty shall not apply to any CAMPBELL SCIENTIFIC, INC. products which have been subjected to modification, misuse, neglect, accidents of nature, or shipping damage. This warranty is in lieu of all other warranties, expressed or implied, including warranties of merchantability or fitness for a particular purpose. CAMPBELL SCIENTIFIC, INC. is not liable for special, indirect, incidental, or consequential damages.

Products may not be returned without prior authorization. To obtain a Returned Materials Authorization (RMA), contact CAMPBELL SCIENTIFIC, INC., phone (435) 753-2342. After an applications engineer determines the nature of the problem, an RMA number will be issued. Please write this number clearly on the outside of the shipping container. CAMPBELL SCIENTIFIC's shipping address is:

CAMPBELL SCIENTIFIC, INC.
RMA#_____
815 West 1800 North
Logan, Utah 84321-1784

CAMPBELL SCIENTIFIC, INC. does not accept collect calls.

Non-warranty products returned for repair should be accompanied by a purchase order to cover the repair.

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CS410 Shaft Encoder

1. General

Shaft encoders monitor fluctuations in water level and the position of water control gates by converting shaft rotation to electronic signals which are then measured by the datalogger.

The CS410 generates two pulse strings—one indicating clockwise and the other counter-clockwise rotation.

The CS410 utilizes a "Silver in Glass" technology for the encoder. The encoder advantages are the environmental ruggedness, low power consumption, and price. One liability is a higher starting torque than some other shaft encoders for water level measurement. For this reason we recommend using a 6 inch diameter disk shaped float to maximize water displacement as the water level changes. With this float it is still possible to see one count of hysteresis (which translates to 0.0078 feet with a one foot pulley) due to the starting torque. If you cannot live with this error, you will need to use a larger float with an idler pulley, or another encoder with less starting torque.

2. Specifications

Compatible Dataloggers: CR10(X), CR500, CR510, 21X, CR23X, CR7

Power supply: 4 to 5.6 volts

Operating temperature: -25 to +50°C

Resolution: 100 counts per revolution

Shaft diameter: 5/16 inch

Maximum cable length: 100 ft (30 m)

Current drain: 0.5 mA

Starting torque: less than 0.125 in oz.

Minimum time between input transitions: 0.75 ms

Output pulse width: 0.25 ms at 25 degrees C

Signal magnitude, Volts: 0 (low), supply voltage (high)

Dimensions (L x W x D, inches): 7 x 4.875 x 4

Weight: 1.8 lbs.

3. Wiring

Black----------GND
Red----------5V
Green ---------P2
White ---------P1
Shield ---------GND

4. Installation

Shaft encoders are typically mounted in a stilling well for protection and to dampen waves. Attach the pulley to the CS410. If you have our pulley, part # 10799, it is secured with a 9/64" hex wrench. Mount the encoder in the stilling well allowing for the pulley and tape to be unobstructed. Attach the end hooks to the tape, followed by the float and counter weight. Then drape the tape over the pulley.

5. Programming

The shaft encoder is measured with Instruction 3.

Multiplier for Instruction 3:

The multiplier is based on the wheel circumference and the shaft encoder counts per revolution:

MULTIPLIER = WHEEL CIRCUM. (in desired units)/ (COUNTS/REV.)

The CS410 has 100 counts/revolution, thus with a 1-foot circumference wheel:

MULTIPLIER = 1/100 = .01 (measures in feet)

5.1 Offset

Since the shaft encoders reference zero at the wheel position at power-up, an offset may be required. The present known reference point can be obtained by reading the water level from the staff gage at the site. You can enter the value into the program by using a portable computer or keyboard/display.

5.2 Program Example

This program collects and processes data; additional instructions are required to send the data to final storage. The data must be in final storage to transfer the data to a storage module or to retrieve the data via a telecommunications link.

```
CR10(X) Program for the CS410:

*Table 1 Program
  01:          5        Execution Interval (seconds)

1:  Pulse (P3)
  01:          1        Reps
  02:          1        Pulse Channel 1
  03:          0        High Frequency, All Counts
  04:          1        Loc [ count_up ]
  05:          1        Mult
  06:          0        Offset
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2:  Pulse (P3)
  01:          1        Reps
  02:          2        Pulse Channel 2
  03:          0        High Frequency, All Counts
  04:          2        Loc [ count_dwn ]
  05:          1        Mult
  06:          0        Offset

;PROCESSING INSTRUCTIONS

3:  Z=F (P30)
  01:        100        F                        ;pulses per revolution
  02:          0        Exponent of 10
  03:          3        Z Loc. [ _100    ]

4:  Z=F (P30)
  01:          1        F                        ;pulley circumference (1 foot)
  02:          0        Exponent of 10
  03:          4        Z Loc. [ circ    ]

5:  Z=X/Y (P38)
  01:          4        X Loc. [ circ    ]
  02:          3        Y Loc. [ _100    ]
  03:          5        Z Loc. [ ft_count ]      ;feet per count

6:  Z=X*Y (P36)
  01:          1        X Loc [ count_up ]
  02:          5        Y Loc [ ft_count ]
  03:          1        Z Loc [ count_up ]

7:  Z=X*Y (P36)
  01:          2        X Loc [ count_dwn ]
  02:          5        Y Loc [ ft_count ]
  03:          2        Z Loc [ count_dwn ]

8:  Z=X+Y (P33)
  01:          1        X Loc [ count_up ]
  02:          6        Y Loc [ stage_ft ]
  03:          6        Z Loc [ stage_ft ]

9:  Z=X-Y (P35)
  01:          6        X Loc [ stage_ft ]
  02:          2        Y Loc [ count_dwn ]
  03:          6        Z Loc [ stage_ft ]

;Set offset once when program compiles

10:  If Flag/Port (P91)
  01:         21        Do if Flag 1 is Low
  02:         30        Then Do

11:  Z=X+F (P34)
  01:          6        X Loc [ stage_ft ]
  02:          0        F                        ;Enter offset here
  03:          6        Z Loc [ stage_ft ]
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12:  Do (P86)
  01:            11          Set Flag 1 High

13:  End (P95)

*Table 2 Program
  02:            0.0000      Execution Interval (seconds)

*Table 3 Subroutines

End Program
```

After downloading the program, test the direction of the float movement by raising the float up above the water level and note the stage value. If it decreases, the direction is incorrect. This can be corrected in two ways: 1) reverse the float and counter weight on the pulley, or 2) reverse the green and white wires going into the pulse ports of the datalogger.

5.3 Entering the Reference Offset

The offset, which sets the stage value equal to some reference point, should be entered after the system has been installed and the float is resting on the water surface. For a stream stage application the offset is the difference between the staff gage reading and the datalogger reading from the encoder. For example; if the staff gage reads 12.25 feet, and the datalogger reads 0.75 feet, the offset would be 11.50 feet (12.25 - 0.75 = 11.50).

For the example program above the offset would then be added to the program and re-downloaded, or the offset could be added using the keyboard display by entering the value in the 11th step of the program. Another option would be to use the *4 link in your program for the offset to avoid having to enter the program tables (see your datalogger manual or Edlog for details).