Hydrographic Survey Products, Inc
Houston – Texas

Smart Sensor Cable Sensor Ver 4.0 Std

LCD Display and Interface Ver. 3.0

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Introduction

This manual covers the following *Hydrographic Survey Products* devices:

The SCC Smart Sensor Cable Counter Sensor Ver 4.
The DVO Video Overlay Interface Unit
The SCC Display & Interface Unit Ver 3.0

The SCC Smart Sensor can be used alone or with either the DVO-2 or the SCC Display & Interface Unit to provide a cable pay-out measuring system for use in the oceanographic and hydrographic industries.
A standard system would consist of an SCC Smart Sensor mounted to a sheave wheel, and a SCC Display / Interface. A deck cable is used to connect the Smart Sensor to the Display / Interface. The deck cable may be a hard connection to the sensor or connected via an underwater connector.
Various Sheave wheels, deck cables and other accessories are available from:

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Section 1: General Information

Introduction

This manual provides general information, hardware description, software operation and installation instructions for the *Hydrographic Survey Products* Smart Sensor Cable Pay-Out Indicator (SCC) system. The Smart Sensor Cable Pay-Out Indicator can be used as a stand-alone sensor or used in conjunction with display modules and video overlay devices available from *Hydrographic Survey Products*.

Smart Sensor General Description

The Smart Sensor Cable Pay-Out Indicator (SCC) is the central component of an automated, cable pay-out indicator system. By integrating all the essential electronics into the sensor, itself, costs have been reduced, whilst retaining all the required capability of higher priced systems. A modular approach has been taken so that the user has only to purchase those functions required. By offering the sensor alone, a very cost-effective upgrade path is available for users with existing, non-instrumented sheave wheels. The SCC may be fitted to almost any suitable, non-magnetic sheave wheel. A number of small magnets, attached to the wheel, are used to sense movement and direction of the wheel and hence movement of the cable as it is deployed or retrieved. The sensor us environmentally sealed, making it ideal for harsh marine and oceanographic applications. The SCC may be used in any situation where an accurate reading of cable length deployed is required.

Once power is applied, the sensor will output an RS232 data stream of the amount of cable paid out. The sensor will update this data in real time as cable is deployed or retrieved. The SCC is an ideal sensor for connection to computerized sonar acquisition systems – all that is required is a free serial port and real time deployed cable length can be logged along with sonar data. The SCC also interfaces easily to LCD displays, Video Overlay Modules and Data Telemetry systems.

Calibration parameters for the Sheave Circumference, Number of Magnets Installed and a Preset Start Point are stored inside the sensor in non-volatile “Flash” memory. All these parameters can be user configured easily in the field with nothing more than a standard PC. In fact, the preset start point may be changed with the use of the Display / Interface unit alone.

In the event that power is lost whilst the cable is deployed and the cable counter is reset, reloading the preset count to the last known cable length can be easily performed.
A mark can be placed on the cable at the preset point and can be used as a calibration check point to ensure that the cable has not slipped on the sheave wheel causing incorrect readings during deployment.

Features

- RS232 Input / Output at 9600 baud (8N1)
- Direct connection to any PC or Telemetry System
- All operating parameters are stored in internal “Flash” memory.
- Bi-color LED indicator on sensor to indicate movement and direction.
- Wide Power supply 8 to 24Vdc. (unregulated).
- Low Power consumption – 15mA @ 12V dc.
- Simple Interface to most sonar acquisition packages.
- No operator intervention required once the sensor is calibrated.
- Measures outgoing and incoming cable length to a resolution of 1 cm up to a maximum of 100KM (99999.9 meters)
- Allows the operator to remotely reverse the sheave rotational sense without the need to more the sheave.
- Options for battery backed display modules, video overlay and deck packages available.
- Deck cable can be supplied in custom lengths
- System can operate in Feed or Meters
- User configurable Sensor ID - A, B, C, or D
- Serial Number hard coded in firmware.

The *Hydrographic Survey Products* SCC may be supplied in a number of configurations:

Option 1 The sensor supplied alone with 10’ polyurethane cable terminated with an RMG-4-MP underwater connector and locking sleeve or with an integrated 50ft deck cable (Other lengths available on request). Or an unterminated urethane cable.

Option 2 The sensor mounted to a 3rd party manufactured sheave wheel. The wheel is normally supplied with a urethane liner and fitted with taper roller bearings. The sheave wheels may be ordered from 6 to 36 inches diameter with various loading capacities. The sheave wheels have working loads from1,500 to 8,000 pounds. The sensor is supplied with 10’ polyurethane cable terminated with an RMG-4-MP underwater connector.

Note: Other Sheave Blocks may be supplied at customers request.

Option 3 The SCC can be fitted to a customer owned and supplied sheave block and calibrated to that wheel. Charges will depend on the particular sheave and any custom fabrication that may be required to install the sensor.

Specifications:

Size	:	3” X 2” X 2” (Environmentally Sealed)
Power	:	8 to 24Vdc @150mA (polarity protected)
Mounting	:	4 X #8 X 32 .
Connector	:	RMG-4-MP (Male Pin) **
Mating Connector	:	RMG-4-FS (Female Socket) **
I/O Cable	:	50ft*** Polyurethane 4 X 20 AWG
Max. Count	:	99999.9 Meters (10kM)
Min. Count	:	00000.0 Meters
Resolution *	:	1cm
Data Output	:	9600 8N1 at 2Hz
Data Input	:	9600 8N1
Data Levels	:	True RS232
Output String	:	$CCANNNNN.NM,+CCCC<cr><lf>
Input String	:	#C+CCCC,PXXXXX<cr><lf> (see appendix A for details)
Indicator	:	Red / Green LED - Cable movement Blue LED – Sensor Power

* Actual resolution of cable out will depend on magnet spacing

** Alternatively, the sensor may be supplied with an integrated deck cable at a reduced cost. Standard cable length is 50 ft but any length up to 200 ft is available.

*** Other lengths available on request

Section 2: Technical Description

The length of cable deployed is measured by counting the movement of the magnets placed on the periphery of the sheave wheel. With knowledge of the wheel circumference and the number of magnets, the magnet spacing may be calculated. It is assumed that there is very little friction to prevent the wheel from freely rotating as the cable passes through the sheave. Thus, the accumulated total number of magnets counted, multiplied by the magnet spacing will yield the total cable deployed. The SCC uses three (3) Hall Effect magnetic switches to count the magnets and the direction of rotation as they pass under the sensor. Note: The Hall switches are unipolar and will only detect a South Pole magnetic field. A software algorithm is used to prevent false counting caused by a magnet “dithering” under the sensor. The deployed cable length data is output as an RS232 string at 9600 baud 8N1 at 2Hz. LED indicators are provided on the sensor to indicate magnet detection and direction (Red / Green) and power to the sensor (Blue).

The calibration factor (distance between magnets) and the preset count (the start value when the sensor is powered up) are both stored in “Flash” memory inside the sensor. These parameters are easily re-programmed in the field with a standard PC, once set they should only require infrequent re-calibration. The flash memory is non-volatile and data integrity is valid for 10 years with no power applied to the sensor. The flash memory may be erased and rewritten over 10,000 cycles.

In most applications the RS232 data will be either directly interface into a data acquisition package or to a display. The SCC can also be interfaced directly to a navigation package so that towed vehicle position can be calculated in real time without the need for expensive acoustic navigation systems. Alternatively, the SCC data may be overlain onto the winch security camera video signal using the *Hydrographic Survey Products* dual channel video overlay interface or displayed on one of the *HSP* Display / Interface modules. Because the deployed cable data is in a standard RS232 ASCII format, transmission by RF or acoustic telemetry is very simple using off the shelf telemetry components.

Connections

A minimum of 3 conductors are required for operation and a 4th required for remote calibration (Data In) as follows:

IP-67	Color	Function	PC Connection	EN3 5 Pin
Pin 1	White	Data Out of Sensor	DB9-2	Pin 1
Pin 2	Black	Gnd.	DB9-5	Pin 2
Pin 3	Green	Data Into Sensor	DB9-3	Pin 3
Pin 4	Red	+8 to 24Vdc		Pin 4
		No Function		Pin 5

Section 3: Calibration

For the SCC to obtain an accurate deployed cable measurement, the sheave wheel must be carefully calibrated before use. Any error in this measurement will be multiplied by the number of turns the wheel makes. To achieve an accurate measurement of the wheel's circumference, a length of cable or rope **the same diameter as the cable that will be deployed is used**. Wrap the cable tightly around the wheel and mark the point at which it crosses itself. Carefully measure and note this distance in units required for operation (feet or meters). When making the measurement, ensure that the cable is positioned in the valley of the wheel when the measurement is taken. If a metric rule is not available, measure in inches and multiply by 0.0254 to obtain the length in meters. For example: if the sheave wheel was measured as 46.125 inches the metric equivalent is:

46.125 X 0.0254 = 1.171575 Meters

The number of magnets will always be an integer, normally between 2 and 6, although any number of magnets may be used.

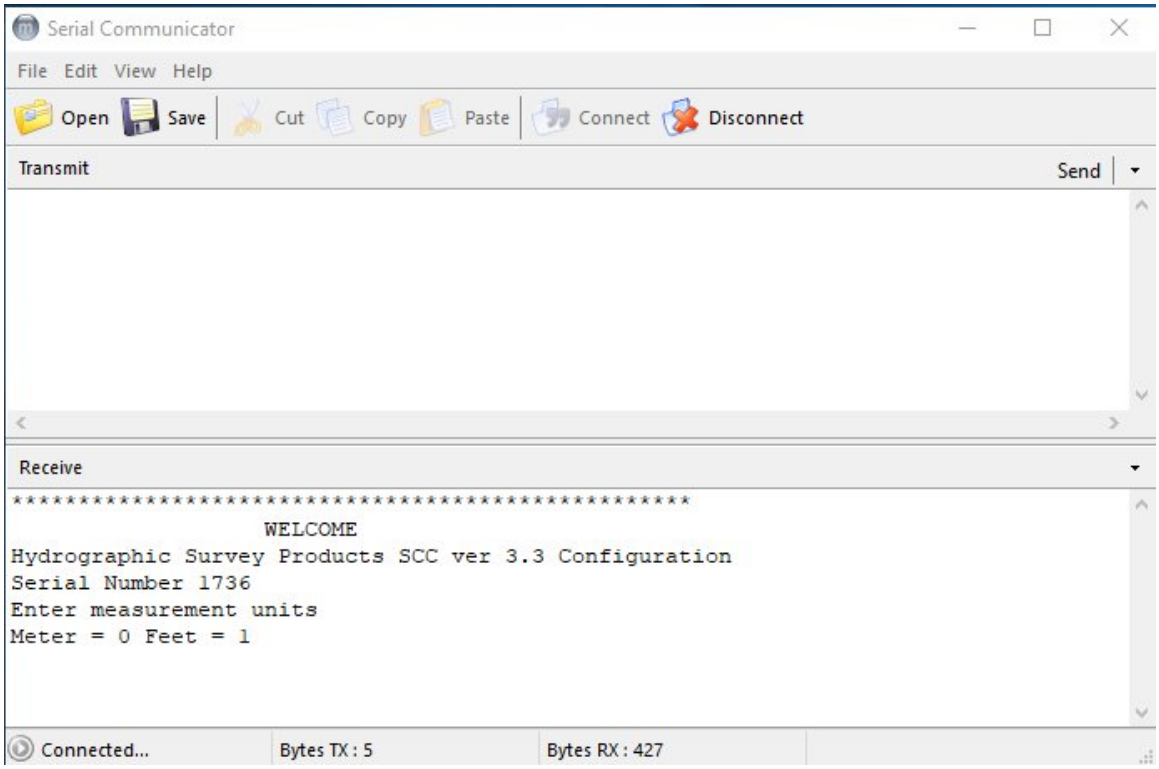
Note: The larger the number of magnets used the greater will be the counter's resolution.

The Cal Value is the Sheave Circumference divided by the number of magnets. The units of the Cal Value are mm if using Meters and 1/000th Feet if using Feet

Once these factors have been measured and noted they may be programmed into the SCC sensor. All version 4 SCC Sensors have a built-in utility that simplifies the sensor configuration procedure.

Connect the Test / Program cable (supplied) to the sensor directly (or using the deck cable). Connect the DB-9 connector to a free serial connector on the PC and run the "SerialCom" utility (supplied). If using Serial Com for the first time do the following:
Right Click in the Transmit window
Check "AutoClear After Transmit"
Check "Transmit on Carriage Return"
Set the Baud rate to 9600 and the Port Number to the serial port that is being used.
Press F9 or Connect to connect the Serial Com utility.
Plug in the 12V Power supply to the Test Cable and enter #C# into the transmit window. The blue LED on the sensor should be on.

A message listing the version number and the sensor Serial Number will be displayed.



Note : Your sensor will have different version and serial numbers

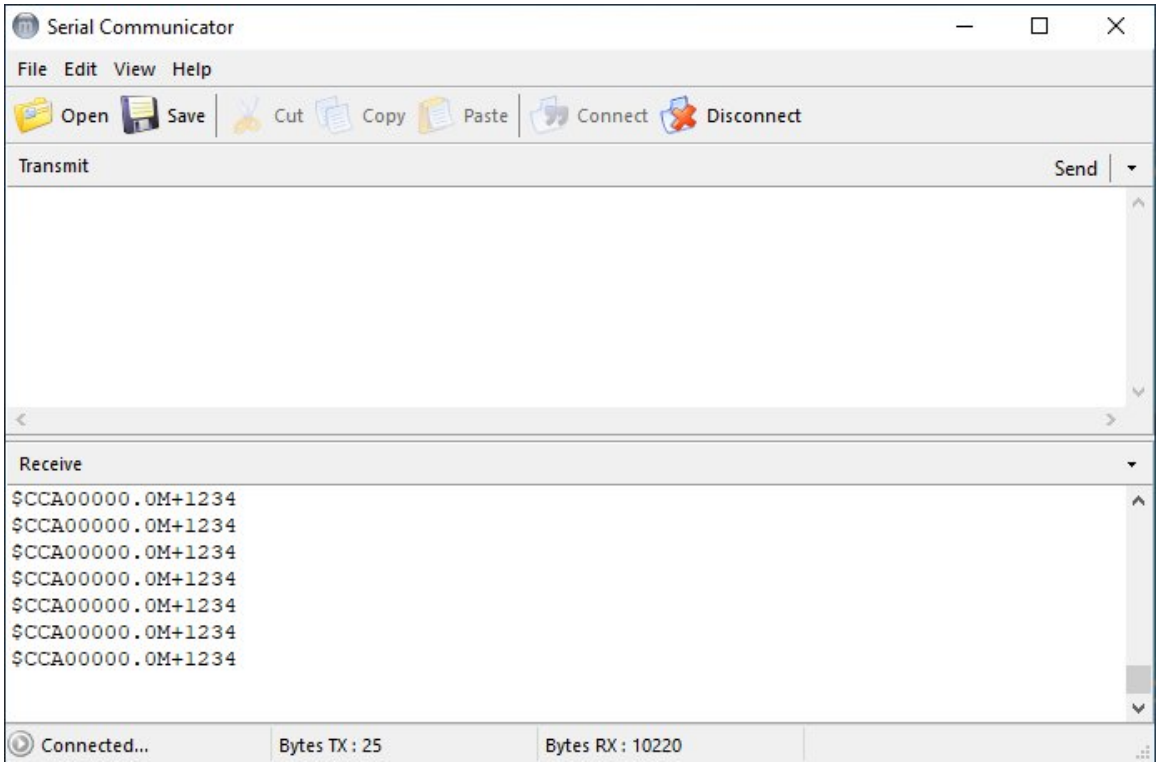
Enter the desired units. Meters or Feet

Enter the desired Sensor Address Character A, B, C or D (not used by the SCC system – for use by external software if required for multiple sensors)

Enter the Cal Value. **This must be 4 digits preceded with a sign** (+ or -) The sign will determine the rotational sense (typically use +). If Meters were entered as the desired units then the Cal Value must be entered as Meters.

Enter the Zero Offset. This must be 5 digits. This is the value that the sensor will start counting from. Typically, the starting point is 00000, however there may be instances where some cable must be deployed before the tow fish is in the water. Use of the Zero Offset will depend on the offset configuration of the acquisition software. The Zero Offsets must be entered in the same units (Meters or Feet) as the desired units.

The Receive window will now begin to display the raw data from the sensor.



All the parameters entered have been saved in flash memory inside the sensor and will be preserved even when the sensor is powered down.

If the sensor is in a position so that it can be observed during the calibration process, the LED on the sensor will flash Red / Green when the calibration data is set, indicating that the new calibration data has been received and stored in flash memory.

Feet / Meters Note: The SCC sensor does not recognize units as such, it simply increments or decrements a number (Calibration factor) to the accumulated total. The default unit is assumed to be meters, however if feet are required then enter both the sheave circumference and preset values in feet. If both the preset value and sheave circumference are entered in feet, then the SCC will output data in feet. Do not mix feet and meters as this will lead to incorrect values. When using the sensor with the SCC Display / Interface, Switch 4 inside the Display / Interface can be set to display and output either Feet or Meters*.

Example Calibration factors for S/N 1789 mounted on a Campbell A1422D 8 Aluminum Sheave Wheel with filled and machined wheel.

The following calibration parameters were measured before delivery and entered into the SCC sensor before shipping.

NOTE:
A 9.7mm diameter cable was used to measure the circumference of the wheel. If using a different diameter cable, you must remeasure with the cable diameter you plan to use with the sheave.

Units	:	Meters
Sensor Address	:	B
Cal Factor	:	+0404 (Meters)
Reset Value	:	00000

Campbell A1422D filled and machined sheave Wheel (Serial No 1789)

Circumference = 5.30201 Feet = 1.616075 Meters
No of Magnets = 4

Calibration Factor = 1326 Feet

OR

Calibration Factor = 0404 Meters

The calibration data has now been written to the internal flash memory and will be read and output after a few seconds. To test that the correct values have been loaded use any terminal program (such as Serial Com) to inspect the output string. The sheave wheel may be rotated by hand to ensure correct operation. The internal flash memory is non-volatile and will not be lost when power is disconnected from the sensor. When the SCC is subsequently powered up, a 10 second delay is implemented while it looks for new calibration data. If no new calibration data is received after 10 seconds, the previously stored data is read from flash memory and used. As a further check that the memory has been retained, the Cal Factor is output along with cable out data, so that a check on the sensor calibration factor is always available.

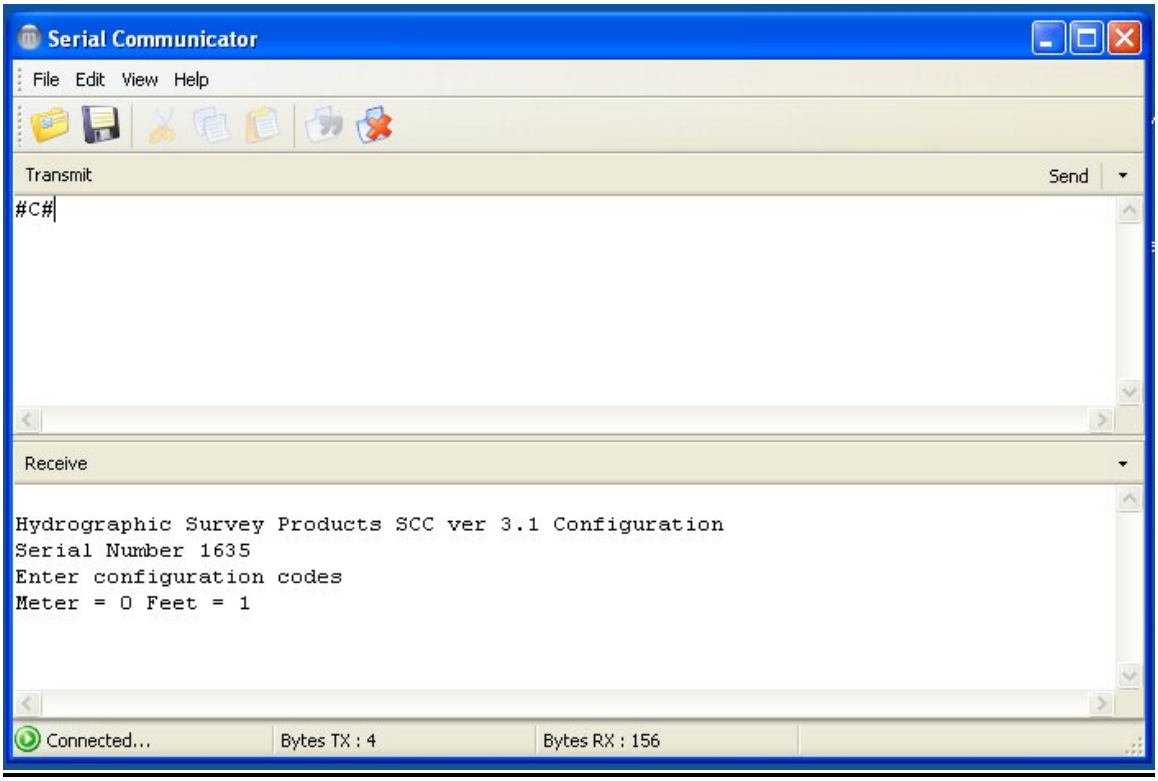
Additional features and options available on SCC sensors with Serial Numbers of 1624 and above and all Version 4 sensors

- Electronic Serial Number Hard coded into the SCC sensor.
- Ability to change the Units descriptor output by the SCC sensor (F or M) *
- Ability to change the Sensor's I.D. character A, B, C or D
- LED will flash after calibration has been completed successfully.

On Display / Interface Ver.3 the unit descriptor (F or M) is read from the sensor and displayed and output automatically.
As with the calibration procedure the above parameters are available during the first 10 seconds after powering up the sensor. After applying power to the sensor, send the following command within 10 seconds:

#C#

The sensor will respond with the version number and serial number and a simple menu to change the above parameters. **Note: the serial and version numbers of the sensor cannot be changed.**



Serial Communicator terminal Utility used to configure the sensor

After this procedure has been completed, the sensor **MUST** be recalibrated as normal. The above settings will be stored in flash memory with the calibration factor and the preset value. A simple terminal program is included on the cd to assist in sending the required data to the sensor, don't forget to clear the transmit window between each transmission if you chose to use this utility.

VERSION 4

The operation and I/O of Version 4 sensors remains unchanged from Version 3 sensors with 2 major changes.

Version 4 sensors use solid state “Hall Sensors” as opposed to mechanical reed sensors used in Version 3. The Hall sensors are more sensitive to the magnetic field and being solid state are much more reliable. The Hall sensors used in Ver 4 sensors are Unipolar, meaning they will operate with a South Pole magnetic field ONLY. The Unipolar operation increases rejection to stray magnetic fields but it is **very important that the magnets fixed to the sheave wheel are orientated with the south pole facing out (toward the sensor).** Determination of the correct orientation is easily accomplished by passing the magnet under the sensor. The LED will flash when a South pole is facing the sensor but will not otherwise.

The other difference between Version 3 and 4 sensors is the mechanical configuration of the sensing element. The Ver 4 sensors require a round hole (1 5/8” hole saw) 40mm with 4 X 8-32 machine screws. This configuration makes sensor mounting much simpler.

Section 4 SCC Display and Interface Unit

The SCC Display / Interface Unit is an accessory that can be used with the SCC Smart Sensor. It provides a 2 line X 20 character Alpha Numeric Display with LED backlight, RS232 Interface and Power supply to the sensor. The Display can be used to reset the sensor (causing a reset to any the predefined preset point) and displays the deployed cable length in real time as well as the average (averaged over a 5 second sample) line speed. A DB-9 connector is provided for data I/O to the sensor.
The upper line of the display indicates the cable length deployed in Meters or Feet. The lower line of the display indicates line speed (in either direction) to the left and the desired Preset Value to the right.

Operation

Connect the Sensor to the Display / Interface Unit using the 5' interface cable and deck cable. Connect a standard DB-9 male-female cable from the DB-9 port to a PC's com port. Apply power using either the included 12Vdc wall mount power supply or an alternate source of 8 to 24 Vdc power (300mA max required). The back light should now be illuminated and can be adjusted for optimal viewing. After a few seconds the display will show version and serial numbers of the display unit after which the deployed cable length. As the system has just been powered up, the deployed cable value will be the preset value saved in the SCC's flash memory. The standard SCC data string will be output from the DB-9 connector at 9600 8N1. To test the operation of the system, the sheave wheel may be rotated by hand and both the display and RS232 data string should be seen to either increase or decrease, depending on the direction of rotation.

The Display / Interface incorporates a simple method of resetting the SCC Smart Sensor to any value. Rotate the PRESET control (lower right of the display) to the desired value. Note: pressing and turning will allow faster adjustment. The Preset Value will be displayed on the lower right of the LCD. When the desired value is reached, press the RESET Push Button / LED on the lower left of the display.
The message:

CONFIRM RESET

If the button if pressed again within a few seconds the message:

RESETTING SENSOR

Followed by:

WAITING FOR SENSOR

If the Reset Push Button is not pressed a second time, the display will revert to the normal operating mode and no changes will have been made. After 10 seconds the standard display will return having been reset to the preset value. This procedure will not change the sensor's calibration value.

Contrast Adjustment

The contrast of the LCD can be adjusted by opening the rear or the display (4-screws) and locate the 10-turn pot on the main pcb marked "contrast" – adjust this for the required viewing contrast.

Calibration

The SCC Smart Sensor is calibrated as described in the SCC section (Section 3) of this manual.

All Display / Interface units manufactured after September 2010 will be Version 3. Version 3 is externally similar to the original version but uses an upgraded processor allowing several options to be implemented. Version 1 & 2 are interchangeable with any sensors. After the calibration factor has been changed a warning message will be briefly displayed warning the operator that this change has been implemented.

Feet / Meters

Many customers have expressed the wish to change the output units between feet and Meters. Sensors manufactured after S/N1624 have the ability to be programmed to output either Feet or Meters and Version 3 Display / Interface Units will display the units output by the sensor. As with the earlier versions of the Display / Interface Units, the sensor and display do not recognize units as such. If the sensor is calibrated in Feet then the output is in Feet. Likewise, if the sensor is calibrated in Meters then the output is in Meters. It is the responsibility of the user to ensure that the sensor is calibrated using the same units as the sensor is programmed for and that any external devices are expecting.

Baud Rate

Version 3 allows the output the output baud rate to be 9600 (default) or 4800. Both are 8N1

Output Data Sentence

Version 3 allows 1 of 4 data sentences to be output. The default is the standard $SCCAnnnnn.nM,Scccc<cr><lf> as output by Version 1 Display / Interface units

and the native output of the sensor. Custom strings can also be implemented if required, contact Hydrographic Survey Products.

Sensor Identifier

The sensor identifier in the RS232 data string (A in the previous example) can now be changed by the user. Options for the sensor identifier are A B C or D. The sensor ID can be used when more than 1 SCC system is being used in a single acquisition system. It is the responsibility of the software to use the sensor ID to distinguish between the various sensors used.

All of the above options are set by either a 4-position DIP switch of by configuring the sensor as previously described. Access to the 4-position DIP switch is by removing the 4 screws and removing the rear panel of the Display / Interface Unit.

Position 1 Output Data String Terminator <cr><lf> or <lf><cr>

Position 2 Sensor Type – Standard Wired or Bluetooth

Position 3 Baud Rate 9600 / 4800 Baud (9600 Default)

Position 4 Overrides the Units Descriptor from the Sensor and changes M to F or from F to M.

After changing any of the switch settings, recycle the power for the jumper configurations to be read at power up.

Connection to the SCC Smart Sensor

IP-67	4-Pin XLR	5-Pin EN3	Color	Function
1	1	1	White	Data from Sensor
2	2	2	Black	Power / Data Ground
3	3	3	Green	Data to Sensor
4	4	4	Red	+8 to 24 VDC Power
		5		No Connection

Power Connector 2.1mm

Center Pin	+8 to 24 VDC (300mA)
Outer Contact	Power Gnd

Data I/O DB-9 Female (use a standard db-9 M-F for Interface)

DB-9 Pin 2	Data From Sensor to PC or Acquisition System
DB-9 Pin 3	Data To Sensor (Calibration data)
DB-9 Pin 5	Data Ground

System Maintenance and Troubleshooting

- The aluminum sheave block should be cleaned with fresh water whenever possible. Being aluminum, it is subject to corrosion when exposed to salt water for long periods. Any general-purpose degreaser / cleaner should be used to remove grease and saltwater debris, then rinse with fresh water.
- The Nylon sheave blocks are less susceptible to corrosion but should also be cleaned with fresh water. The bronze bearing does not require lubrication.

- Apply marine grease to the bearings using the standard grease fitting on the center hub.

- Inspect the wheel bearing for binding and end float.

- Inspect the urethane wheel liner for separation.

- Inspect the deck cable for cuts and nicks.

- Ensure all screws and bolts on the sheave are tight.

- The SCC sensor itself is an environmentally sealed unit and should not require maintenance, other than washing with fresh water.

- Periodically, separate the connection (RMK-4) and re grease the rubber parts of the connector with silicon grease.

Trouble Shooting

It is possible that the data stored in the SCC's flash memory can become corrupt (possibly caused by welding equipment or other high current devices used in the vicinity). Before returning the sensor for repair / replacement it may be worth performing the calibration procedure to reset these parameters.

The calibration of the sheave wheel should be checked periodically, wear of the urethane liner could cause slight changes in the wheel's circumference.

The sensor can be directly connected to a PC to inspect the native data string. This procedure can be useful in eliminating possible problems with the Display / Interface and the deck cable.

The Lightweight “Loomis” 6” Sheave Blocks

To meet the demand for lighter weight sheave blocks primarily required for hand deployed Kevlar cables, HSP have integrated the Ver 4 sensor to these commercially available sheave blocks.

A few modifications were required to allow the block to function in this role.
As supplied the Loomis blocks are not “snatch blocks” ie they cannot be opened easily to allow the tow cable to be installed.
To install the cable, follow these steps:

1. Unscrew the top Allen bolt near the swivel (top of the sheave). Use a 7/16 back-up socket wrench.
2. Remove the Allen bolt, swivel and spacer.
3. Insert the cable between the side plates
4. Reinstall the spacer, swivel and Allen bolt.