Hydrographic Survey Products, Inc
Houston – Texas

Blue Tooth Smart Sensor Cable Pay-Out Sensor

Tel. (713) 302 3710

Introduction

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

The SCC Smart Sensor Cable Counter with Blue Tooth Interface.
SCC BT Battery Charger

The SCC Smart Sensor BT is a standalone, battery powered sensor that can be installed on almost any Oceanographic sheave block. Data from the sensor is typically received by any Blue Tooth equipped computer. A dedicated Display / Interface unit is available from Hydrographic Survey Products if required. Also available from Hydrographic Survey Products is a Blue Tooth Active Antenna and a portable display.

Hydrographic Survey Products, Inc
2630 Baycrest Drive
Houston, Texas 77058
(713) 302 3710
tseward@hydro-ltd.com

The SCC BT Sensor mounted to Campbell 12" Sheave Block

Section 1: General Information

Introduction

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

Blue Tooth 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 is 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 ASCII data stream of the amount of cable paid out via a Blue Tooth link to a Blue Tooth enabled device. The sensor will update this data in real time as cable is deployed or retrieved. The SCC BT is an ideal sensor for connection to computerized sonar acquisition systems – all that is required is a Bluetooth equipped PC enabling real time deployed cable length to 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 of these parameters can be user configured easily in the field with nothing more than a standard PC. A mark can be placed on the cable at a 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. If the Blue Tooth connection is interrupted, counting will continue and the correct count will be output once the BT connection is reestablished.

Features

- Blue Tooth V2.0 Protocol Standard.
- Internal Li Ion battery allowing for at least 12 hours operation
- 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.
- Low Power consumption
- 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).
- Units can be user configured to Feet or Meters
- Allows the operator to remotely reverse the sheave rotational sense without the need to more the sheave.
- User configurable Sensor ID - A, B, C, or D
- Serial Number hard coded in firmware.
- Power save mode.

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

Option 1 The sensor supplied alone. Purchaser can then install the sensor onto their sheave block of choice.

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 10 to 36 inches diameter with various loading capacities. The sheave wheels have working loads from 3,500 to 8,000 pounds. The sensor, battery enclosure and magnets will be installed and the system calibrated and tested.

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

Option 3 The BT-SCC sensor 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	:	3¼" X 2¼" X 1¼" (Environmentally Sealed)
Power	:	Internal 3.7V battery
Mounting	:	4 X #8 X 32 thru holes.
Connector	:	Switchcraft EN3 5 pin Female
Mating Connector	:	Switchcraft EN3 5 pin Male
Max. Count	:	99999.9 Meters (10kM)
Min. Count	:	00000.0 Meters
Resolution *	:	1cm
Data Output	:	Blue Tooth V2.0
Data Rate	:	2Hz or on change.
RF Output	:	2.40GHz to 2.48GHz ISM Band
RF Power Level	:	Class 2 (+6dBm)
Recv Sens	:	-85dBm
Output String	:	$CCANNNNN.NM,+CCCC<cr><lf>
Input String	:	#C+CCCC,PXXXXX<cr><lf> (see appendix A for details)
Indicator	:	Red / Green LED.

* Actual resolution of cable out will depend on magnet spacing

Power Plug and Connector Wiring

SwitchCraft EN3 Series water resistant connector

Pin 1	Sensor Ground	
Pin 2	LED Red	
Pin 3	LED Green	
Pin 4	3.7V Power Input	>
Pin 5	+ve Battery	> Linked when plug connected (Pin 4 & 5)

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) internal magnetic sensors to count the magnets and the direction of rotation as they pass under the sensor. 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 ASCII data string at 2Hz. A LED indicator is provided on the sensor to indicate magnet detection and direction.

The calibration factor (distance between magnets on the wheel circumference) 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 BT data will be either directly interfaced to a data acquisition package running on a PC 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.

Internal Battery

Because the SCC_BT is designed as a self contained, battery powered sensor, some steps were incorporated to increase battery life. The Power Save (PS) mode is activated using the internal set-up utility (see calibration section). When the sensor is in Power Save mode, data is only output when the cable out value changes. In most applications, the cable will be deployed to the desired length and then remain undisturbed for some time as data is collected. Clearly, if the deployed cable length is not changing then there is no need for the sensor to continually output the same data string. By not sending the data string at the normal 2Hz, the Bluetooth module can enter the “sleep mode” which will considerably extend the battery life. An option has also been added to the Power Save mode but output 1 data string every 15 seconds, even if the deployed cable length has not changed. This mode can be used to prevent the acquisition software from “timing out” and causing an error message to be displayed. Power save mode (output on change) with the 15sec output rate is the default output setting.

At all times the battery connector should either be protected with the connector cap or with the operate plug in place.

Bluetooth Pairing

The Bluetooth module used in the SCC sensor is a Slave Only designed as a wireless Serial Bridge.

The pairing procedure will depend on the platform and operating system to which the SCC is to be paired. For a typical Windows system:

Go to My Bluetooth Places – Add Bluetooth Device.

The SCC Sensor should then show up as “SCC_17XX”
Double click this icon and you will be asked for the Bluetooth password for this device.

Enter Password **1234** This is a default Bluetooth password

When connected the data from the SCC sensor will be routed to a virtual com port. The Windows Device Manager will list the com ports as a Bluetooth Communications Port and assign it the next available com port number (See Fig 1).
You will use the Com port number to configure the Serial Com utility supplied and any application software that will be used with the SCC data.

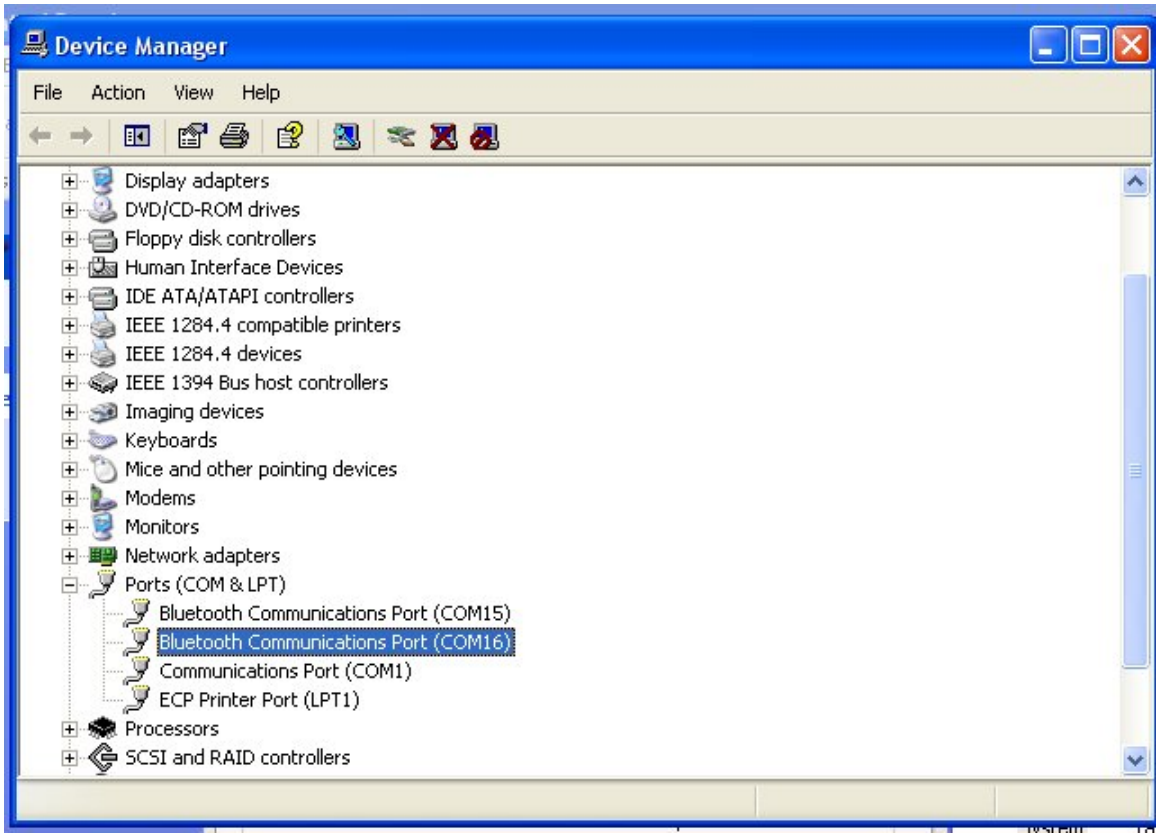

Fig 1 Windows Device Manager

Section 3: Calibration and Setup

For the BT-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 0.3048 to obtain the length in meters. For example: if the sheave wheel was measured as 34 1/8 inches (Campbell A1412B) the metric equivalent is:

34.125 inches = 2.84375 feet = 0.866775 Meters

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

Cal Factor in Feet = (2.84375 / 2) = **1422**
Cal Factor in Meters = (0.866775 /2) = **0433**

Note: As the urethane liner wears the sheave circumference may change over a period of time. It is good practice to check the calibration factor periodically.

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

A very simple, configuration utility has been incorporated into the BT-SCC sensor enabling many parameters to be set by the operator. To enter this utility the command**: !!RTCONF**<cr><lf> is sent to the sensor.

Using the internal configuration utility

- Power up the sensor and allow the Blue Tooth to pair with the PC.
  To power up the sensor, insert the "Operate Plug" into the 5 pin connector on the side of the sensor. Rotate the locking ring clockwise to prevent the plug from falling out during operation. The LED in the plug will flash Red twice then Green twice then off.

Note: Before using Serial Com for the first time, right click in the transmit window and check following boxes: (see Fig 2)

Auto Clear After Transmit
Transmit on Carriage Return

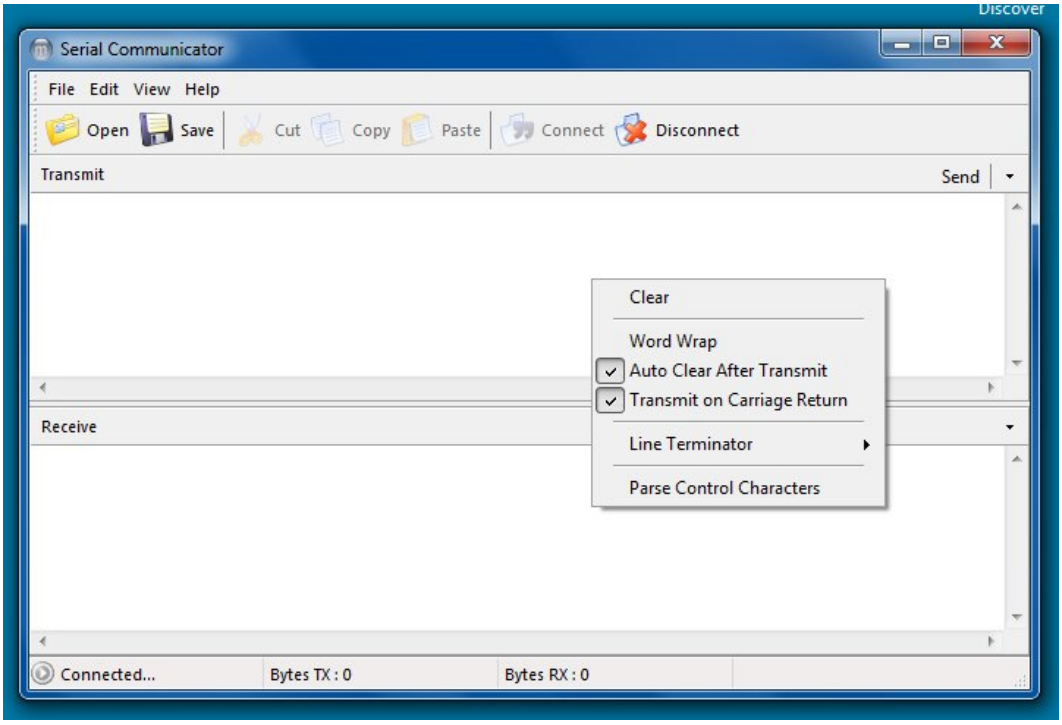

Fig 2 Serial Com Configuration

- Using the Serial Com utility send **!!RTCONF** <Enter> in the Transmit window. Setting should be *9600 8N1* to the com port assigned to the BT port.

- A short message will be displayed in the receive window (Fig 3). The LED in the operate plug will illuminate solid red.

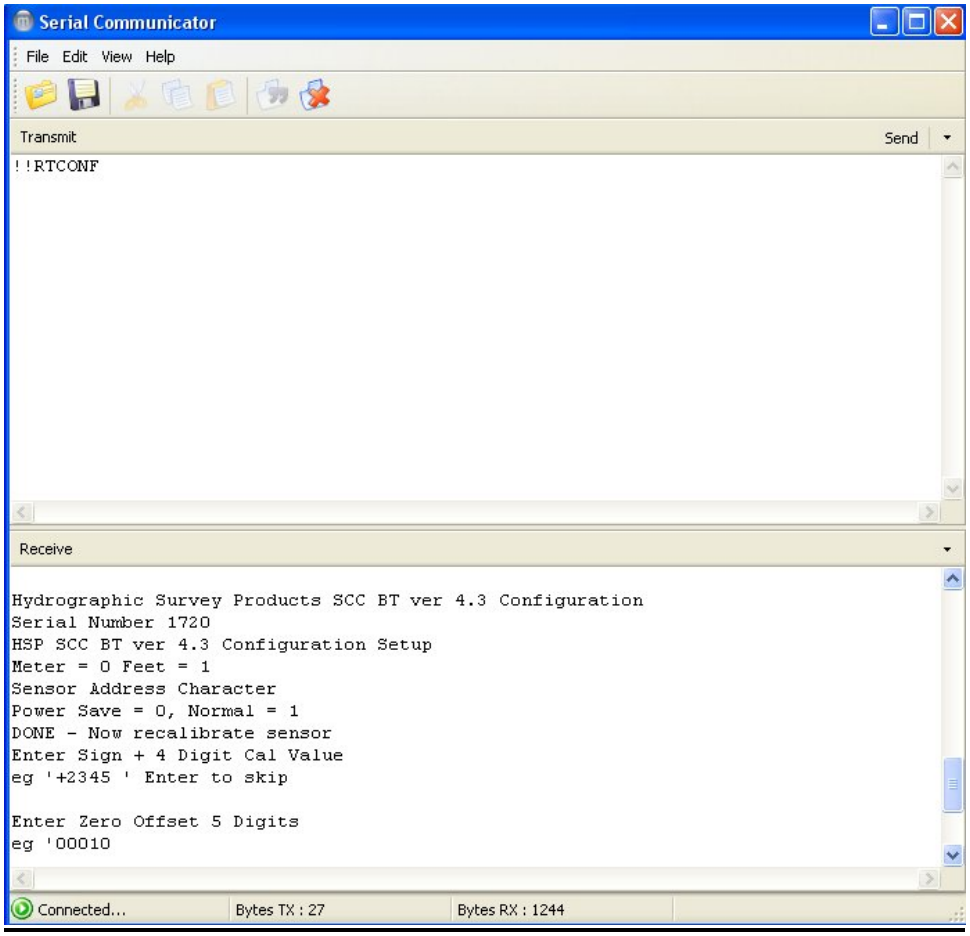

Fig. 3 Configuration Settings

- Enter 0 for Meters or 1 for Feet. These units should be the same as will be used for the calibration factor.

- Enter Sensor ID A,B,C,D. The sensor ID can be used to identify a particular sensor when multi-sensor installations are used. This setting will not affect the sensor operation in any way except to change the string header.

- Enter Power Save Mode Option.
  For normal Output (2Hz) enter 1. This will cause the Blue Tooth to continually send data at a rate of twice per second. To increase battery life, an option to only send new data on change has been added. During a normal survey, the cable is deployed to an operation point and then left

stationary for the majority of the time. To increase battery life the Blue Tooth module will enter sleep mode during this period.
To use Power Save Mode enter 0.

- Enter output rate
  When in the Power Save Mode an option has been added to send a data string at 15 second interval as well as whenever the cable is moved.
  Enter 1 to allow this option and 0 to only output on change (when cable is moved). Outputting data at 15 second intervals will slightly reduce battery life. For maximum battery life, use Only on Change.

- Enter the calibration factor. The calibration factor is the circumference of the sheave wheel divided by the number of magnets. Do not enter a decimal point (4 digits only). The units are 1/1000th Meter (when using meters) or 1/1000th Foot (when using feet)
  The calibration factor should be preceded by a sign + or -. The sign of the calibration factor will reverse the counting sense of the sheave wheel.
  Note: The units used (Feet or Meters) will determine the units output by the sensor.

- Enter the offset or preset value. The offset number is the point at which counting will start. The preset value can be any 5 digit number from 00000 to 99999. Always enter 5 digits (add leading zeros if required).

- The above parameters will now be stored in internal non-volatile memory and the sensor will be ready for operation. Be sure to check the output string to ensure that the calibration factor, units, sensor ID and preset value are as entered in the above procedure.

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. The SCC will not convert feet to 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 or Windows Terminal) 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.

Note: the serial and version numbers of the sensor cannot be changed.

Calibration factors for the SCC S/N 1771 installed on Campbell 12" Sheave Wheel.

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

Units	:	Meters
Sensor Address	:	D
Power Save Mode	:	NORMAL
Cal Factor	:	+0413 (Meters)
Reset Value	:	00000

Campbell 12" Sheave Wheel

Circumference = 0.8255 Meters
No of Magnets = 2

Calibration Factor = 0413 Meters

If Imperial measurements are required the Cal Factor will be 1354 Feet.

The above values should be checked. Measure the circumference with a cable of the same diameter as being used.

Resetting the Sensor Cable Out

Use Serial Com at any time after the sensor is paired to reset the cable out Enter the following in the transmit window:

!!RTRRRRR <Enter>

where RRRRR is the required reset value Fig 4

Note: All 5 digits must be entered with leading zeros if required.
Only a whole number may be entered as the reset value.

The output will immediately be updated at the new cable out value. When resetting the cable out in this manner the reset value is not stored and if the sensor power is recycled the reset will revert to the value entered during the configuration procedure.

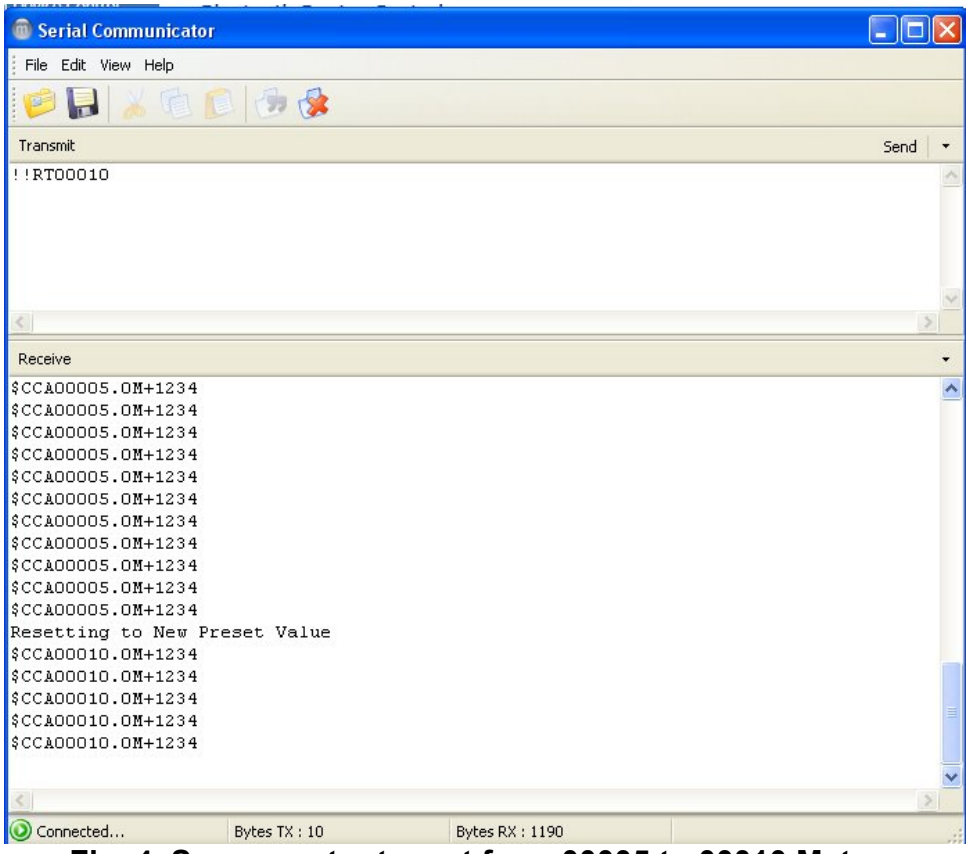

Fig. 4. Sensor output reset from 00005 to 00010 Meters

Battery Charging

The SCC sensor may be recharged while installed on the sheave wheel or the sensor may be removed and charged at another location.

- Remove the operate plug from the SCC Sensor
- Connect the battery charger to the SCC Sensor
- Plug the battery charger into a USB connector
- The Red Led on the charger should light, indicating the battery is being charged.
- When the Red Led goes off and the Green is lit, the battery is fully charged and the SCC can be operated as normal. All operating parameters will remain in memory after the battery has been charged. If the SCC sensor has been removed from the sheave wheel for charging it should be replaced with the same hardware.
- If the SCC sensor is not being used on a regular basis the battery should be charged periodically.
- The SCC sensor cannot be operated whilst being charged.

To remove the sensor from the Campbell 12” sheave block remove the 4 nuts on each corner of the sensor and slide the sensor off the threaded screws.

- **WARNING !!! ONLY USE THE BATTERY CHARGER SUPPLIED WITH THE SCC SENSOR – DO NOT USE ANY OTHER CHARGER OR POWER SOURCE TO CHARGE THE SENSOR. FAILURE TO OBSERVE THIS WARNING COULD LEAD TO DAMAGE TO THE SENSOR AND POSSIBLE FIRE.**

Battery Charger Specification

DC Input:	5V
Output Current::	0.1A
Max. Input Power:	500mA
Frequency (Input)	N/A
Output Voltage:	4.2V 0.5A
Protection:	Short Circuit Protected
Efficiency:	>60%
Operate Temp:	-10°C to +40°C
Humidity:	<+ 90%

SCC BT USB Battery Charger

Battery Charger connections

SwitchCraft EN3 Male

Pin1	Ground
Pin 5	+4.2 V Charging Voltage

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.
- 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.
- 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.
- Charge the SCC BT battery on a regular basis when not in regular use.

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.