Using Sea-Bird Scientific (Satlantic) PAR Light Sensors

Introduction

This application note applies to Sea-Bird Scientific (Satlantic) PAR sensors used with Sea-Bird CTDs:

- **Underwater Sensor**—connected directly to CTD A/D voltage channel and mounted on CTD or CTD cage—Satlantic PAR sensor with **Logarithmic Analog** output. This sensor can be integrated with the following CTDs: SBE 9*plus*, 16, 16*plus*, 16*plus* V2, 16*plus*-IM, 16*plus*-IM V2, 19, 19*plus*, 19*plus* V2, 25, and 25*plus* CTDs.
- **Surface Sensor—**connected to Deck Unit—Satlantic PAR Sensor with **Linear Analog** output or with **Logarithmic Analog** output. If the SBE 11*plus* or 33 Deck Unit is configured with the A/D converter, it can acquire the output of a Surface PAR sensor and integrate this into the CTD data stream.
    - A/D converter is standard in all SBE 11*plus* V2 Deck Units (serial number 489 and greater) and optional in SBE 11*plus* V1 Deck Units (serial number 488 and lower).
    - A/D converter in SBE 33 Deck Units is standard.

Seasoft V2 software fully supports the acquisition and display of the data from these PAR sensors (**version 7.26.7 and later** of Seasave V7 and SBE Data Processing).

Set Up Deck Unit to Integrate with a Surface PAR Sensor

The bulkhead connector on the Deck Unit back panel (labelled *Surface PAR* for SBE 11*plus* and *Par Input* for SBE 33) is a 4-pin MS3102A14S-2S. A spare 4-pin MS style connector (MS3106A14S-2P) was supplied if a cable was not provided.

Deck Unit	Function	Surface PAR Sensor
Pin A	Signal (ground)	Pin 3
Pin B	Power (+12 volts)	Pin 4
Pin C	Power (ground)—Deck Units with Digital PCB Assembly 40937c or greater use Pin C. All previous versions do not use Pin C.	Pin 1
Pin D	Signal	Pin 2
-	-	Pin 5

SBE 11*plus* Deck Unit Configuration

This deck unit is used with SBE 9plus CTD.

1. Set up the Deck Unit to add Surface PAR voltage to the CTD data stream (increasing number of words by 1):
    - **SBE 11*plus* V1**: Set DIP switch S3 position 8 to OFF. The surface PAR voltage will be displayed at thumbwheel position B (or position 11 if your Deck Unit thumbwheel is labeled 0 – 15).
    - **SBE 11*plus* V2**: Refer to the SBE 11*plus* manual (V2) to send the appropriate commands. The surface PAR voltage will be displayed on the Deck Unit LED when the thumbwheel is set to position 9.
2. Plug the cable connected to the Surface PAR sensor into the *Surface PAR* connector on the back of the Deck Unit.
3. To convert to actual voltage, divide the number displayed on the Deck Unit LED by 819:
   Voltage = displayed number / 819.

SBE 33 Deck Unit Configuration

Note: These deck units are used with SBE 16, 16plus, 16plus V2, 19, 19plus, 19plus V2, 25, 25plus, and 49 CTD.

1. Set up the Deck Unit to add Surface PAR voltage to the end of the CTD data stream (increasing number of Hex data bytes by 3). Setup varies, depending on the Deck Unit firmware version (refer to the Deck Unit manual).
    - **Deck Unit firmware < 3.0:** Locate the NMEA Interface PCB with optional A/D converter under the bottom cover panel of the Deck Unit. Verify that dip switch S1 position 8 is in the OFF position.
    - **Deck Unit firmware ≥ 3.0:** In Seaterm, verify that the SBE 33/36 status message on power-up shows `Surface PAR enabled`. If it does not, type `@` to access the setup menu, and then type `6` and press the Enter key to enable Surface PAR acquisition.
2. Plug the cable connected to the Surface PAR sensor into the *PAR Input* connector on the back of the Deck Unit.

Configuring Software

Note: In our Seasoft V2 suite of programs, edit the CTD configuration (.con or .xmlcon) file using the Configure Inputs menu in Seasave V7 (real-time data acquisition software) or the Configure menu in SBE Data Processing (data processing software).

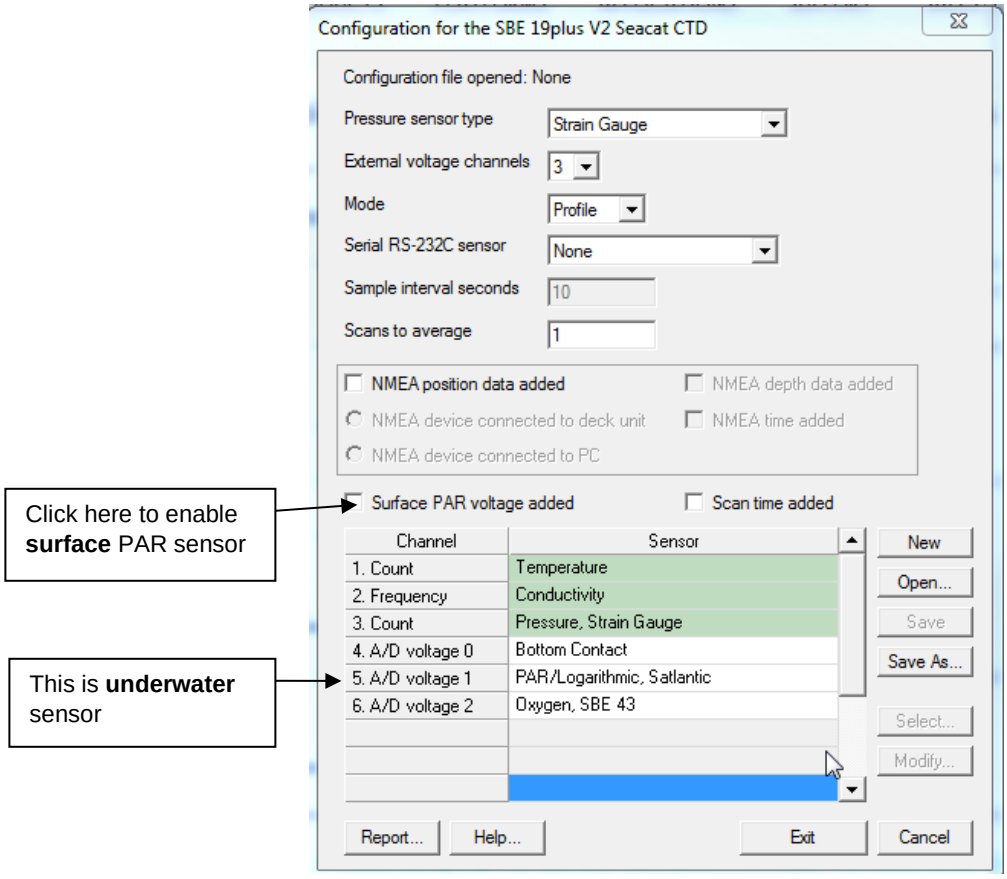
Set up the configuration (.con or .xmlcon) file for the appropriate CTD. Example screens shown below are for the SBE 19*plus* V2.

Underwater Sensor

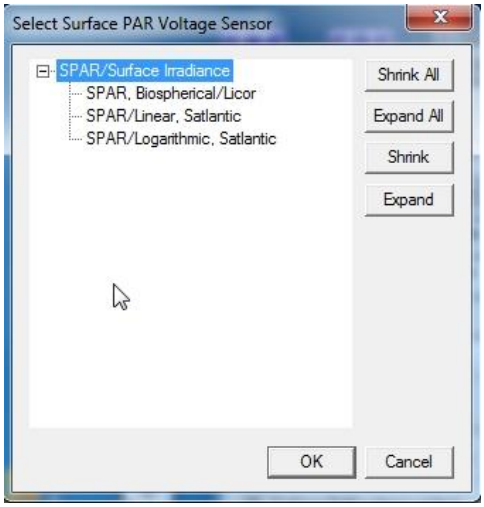
1. Select *PAR/Logarithmic, Satlantic* for the A/D voltage channel corresponding to the CTD bulkhead connector, and click OK. The calibration coefficient dialog appears.
2. From the calibration sheet, enter **a0**, **a1**, and **Im**. Select the **conversion units** (which appears in the data file header; this selection does not modify the calculated values) and enter the **multiplier** (multiplier = 1.0 for units of µmol photons/ m^2 sec) corresponding to the desired units (see Application Note 11General). Click OK.

Surface Sensor (if applicable)

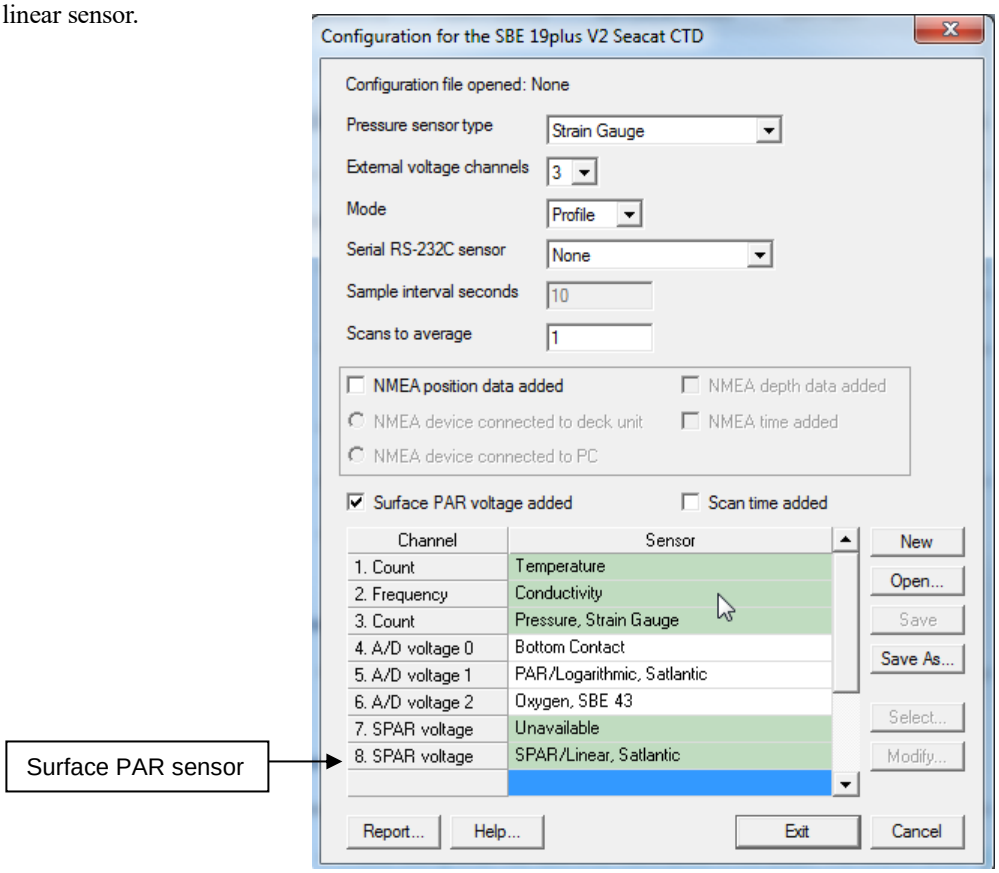
1. Enable the surface PAR sensor by selecting *Surface PAR voltage added*.



2. The Select Surface PAR Voltage Sensor dialog appears. Select *SPAR/Linear, Satlantic* or *SPAR/Logarithmic, Satlantic*, and click OK.



This alters the Channel/Sensor display by adding two additional external voltages. The highest numbered voltage is labeled *SPAR/Linear, Satlantic* or *SPAR/Logarithmic, Satlantic* (as applicable). The example shown below is for the linear sensor.



3. Double click on *SPAR/Linear, Satlantic* or *SPAR/Logarithmic, Satlantic* in the Channel/Sensor display. The calibration coefficient dialog box appears.
   A. Enter calibration coefficients **a0**, **a1**, **Im**.
   B. Select the **conversion units** (which appears in the data file header; this selection does not modify the calculated values) and enter the surface light **conversion factor** corresponding to the desired units (see Application Note 11General).
   C. Enter the **ratio multiplier**.
   D. Click OK.

Equations

Underwater PAR

Seasoft calculates light from an **underwater Satlantic logarithmic analog PAR** sensor as:

PAR = multiplier * Im * 10 $^{(V - a0) / a1}$ [user-selected units]

where

- V = voltage output
- a0, a1, and lm are from the PAR calibration sheet that was provided by Satlantic
- multiplier = 1.0 for units of µmol photons/ m^2 sec (see *Notes*)

Surface PAR

Seasoft calculates surface light from a **Satlantic Surface PAR** sensor as:

Linear analog Surface PAR = Im * a1 * (V − a0) * conversion factor [user-selected units]

Logarithmic analog Surface PAR = conversion factor * Im * 10 $^{(V - a0) / a1}$ [user-selected units]

where

- V = voltage output
- a0, a, and Im are from the Surface PAR calibration sheet that was provided by Satlantic
- Conversion factor =1.0 for units of µmol photons/m^2·s (see *Notes*)
- Ratio multiplier is used in corrected PAR calculation (see *Notes*)

Seasoft calculates **corrected PAR** as:

corrected PAR = 100 * ratio multiplier * underwater light / surface light

(underwater light is the calculated light output from the underwater PAR sensor)

Notes:

- To output underwater PAR and Surface PAR in units other than µmol photons/m^2·s, modify the multiplier (for the underwater sensor) and the conversion factor (for the surface sensor). See **Application Note 11General** to convert units.
- To compare the *shape* of data sets taken at disparate light levels, the **ratio multiplier** (input along with the Surface PAR calibration coefficients) can be used to *scale* the data. For example, a ratio multiplier of 10 would make a 100 µmol photons/m^2·s light level plot as 1000 µmol photons/m^2·s. **Set the ratio multiplier to 1 for normal operations.**