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APPLICATION NOTE NO. 11S

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**Using Biospherical Surface PAR Light Sensor
 with SBE 11*plus* Deck Unit**

If the SBE 11*plus* 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. The A/D converter is standard in all V2 Deck Units (serial number 489 and greater) and optional in V1 Deck Units (serial number 488 and lower). This application note applies to the following Surface PAR sensors (the corresponding underwater PAR sensor, mounted on the SBE 9*plus* CTD or cage, is also shown):

Surface PAR Sensor	Corresponding Underwater PAR Sensor	
	If underwater PAR sensor connected directly to CTD A/D voltage channel	If underwater PAR sensor interfacing to PN 90310 Log Amp Module, which is connected to CTD A/D voltage channel
QSR-240 or QSR-2200	QSP-200L, QSP-2300L, or QSP-2350L	QSP-200(PD) or QSP 2200(PD)
QCR-240 or QCR-2200	QCP-200L, QCP-2300L, or QCP-2300L-HP	QCP 2200(PD)

Notes:

- QSR-240, QCR-240, QSP-200L, QSP-200PD, and QCP-200L are no longer in production by Biospherical.
- See Application Note 11 QSP-L for details on the QSP-200L, QCP-200L, QSP-2300L, QSP-2350L, QCP-2300L, and QCP-2300L-HP underwater PAR sensors.
- See Application Note 11 QSP-PD for details on the QSP-200(PD), QSP-2200(PD), and QCP-2200(PD) underwater PAR sensors.

Our SEASOFT V2 software fully supports the acquisition and display of the data from these surface reference PAR sensors and the corresponding underwater PAR sensor.

1. SBE 11*plus* CONFIGURATION

- A. Configure as follows to add the surface PAR voltage to the CTD data stream (increasing the number of words in the system 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.

- B. Plug the cable connected to the surface PAR sensor into the 4-pin MS connector labeled *Surface PAR* on the back of the Deck Unit. A spare 4-pin MS style connector (MS3106A14S-2P) was supplied if a cable was not provided. The surface PAR bulkhead connector on the back panel of the SBE 11*plus* is an MS3102A14S-2S.

Deck Unit	Function	Surface PAR Sensor with Switchcraft Connector
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

Note: Biospherical sold the Surface PAR sensor with other connector types in the past. See the appropriate drawing for pinout details if your sensor does not have a Switchcraft connector.

- C. To convert to actual voltage, divide the number displayed on the Deck Unit LED by 819:
 Voltage = displayed number / 819.

2. SOFTWARE CONFIGURATION

Set up the configuration (.con or .xmlcon) file for the SBE *9plus* CTD. Enable the recording of the surface PAR sensor by selecting *Surface PAR voltage added*. This alters the display by adding two additional external voltages. The highest numbered voltage is labeled **SPAR/surface irradiance**. Enter the surface light **conversion factor** and the **ratio multiplier** in the configuration file.

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).

SEASOFT calculates surface light as:

$$\text{surface light } (\mu\text{Einsteins}/\text{m}^2\cdot\text{sec}) = \text{volts} * \text{conversion factor}$$

To compute the **conversion factor**, calculate the output of the surface PAR sensor in $\mu\text{Einsteins}/\text{m}^2\cdot\text{sec}/\text{volt}$ using the data from the Surface PAR calibration sheet that was provided by Biospherical (located in the CTD manual).

$$\text{Conversion factor} = \text{Output in Air} / \text{Probe Net Response}$$

For example, if Probe Net Response = 85.6 mV (0.0856 volts) and Output in Air = 0.01384 $\mu\text{Einsteins}/\text{cm}^2\cdot\text{sec}$:
Conversion factor = $(0.01384 \mu\text{Einsteins}/\text{cm}^2\cdot\text{sec}) * (10000 \text{ cm}^2/\text{m}^2) / 0.0856 \text{ volts} = 1617 \mu\text{Einsteins}/\text{m}^2\cdot\text{sec}/\text{volt}$

SEASOFT calculates corrected PAR as:

$$\text{corrected PAR} = 100 * \text{ratio multiplier} * \text{underwater light} / \text{surface light}$$

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

To compare the *shape* of data sets taken at disparate light levels, the **ratio multiplier** can be used to *scale* the data. For example, a ratio multiplier of 10 would make a 100 $\mu\text{Einsteins}/\text{m}^2\cdot\text{sec}$ light level plot as 1000 $\mu\text{Einsteins}/\text{m}^2\cdot\text{sec}$. **The ratio multiplier should be set to 1 for normal operations.**

Notes:

- **Do not enter the Calibration factor from the Biospherical calibration sheet as the Conversion factor in SEASOFT.**
- To output Surface PAR in units other than $\mu\text{Einsteins}/\text{m}^2\cdot\text{sec}$, multiply the calculated Conversion factor to obtain the desired units. See Application Note 11 General to convert units.
- See Application Note 11 QSP-L or 11 QSP-PD, as applicable, for instructions on entering the underwater PAR sensor coefficients.