



SEA-BIRD
SCIENTIFIC

Quick Start Guide

Version 001

SeaFET™ V2

Shallow SeaFET V2
Shallow SeapHOx V2
Deep SeapHOx V2

Introduction

The SeaFET™ V2 is an upgrade to the Satlantic SeaFET™ pH sensor. It incorporates the same housing and DuraFET (shallow SeaFETs only) as the SeaFET V1 with improved electronics and new operating characteristics. Sea-Bird can optionally integrate a Shallow SeaFET V2 with an SBE 37-SMP-ODO CTD to operate as a SeapHOx V2. The Deep SeapHOx V2 is always integrated with a 37-SMP-ODO. The SeaFET V2, SeapHOx V2, and Deep SeapHOx V2 have new command sets that are different from the SeaFET V1.

The Sea-Bird Scientific UCI software is the primary interface with the SeaFET V2. UCI is loaded with tools for configuring the SeaFET V2 and handling data before and after the deployment. Users can also interface with the SeaFET V2 via a terminal emulator such as Tera Term. SeaFETCom is not compatible with V2 SeaFETs.

This guide outlines major differences from the SeaFET V1 as well as general use and communication with the SeaFET V2. Maintenance and care instructions for the SeaFET V1 are still valid; refer to the SeaFET V2 manual for information about maintenance, care, and deployment considerations.

Primary Differences from the SeaFET V1

The SeaFET V2 shares the SeaFET V1's external hardware and physically looks identical from the outside. However, due to new internal electronics, the SeaFET V2's commands and operating characteristics are more similar to other Sea-Bird CTDs, such as the SBE 37 MicroCAT CTD.

Hardware

The Magnetic Switch and Indicator LED function differently from the SeaFET V1. Instead of turning the instrument on and off, the magnetic switch now allows the user to determine the instrument status:

No Flash: SeaFET V2 batteries/memory are not ready for deployment	Red Flash: SeaFET V2 has not received a sampling command	Green Flash: SeaFET V2 is sampling or waiting to begin sampling
<p>The LED will not flash if any one of the following conditions are true:</p> <ul style="list-style-type: none"> • The RTC battery is not sufficient (below 2.5 V) • The isolated battery is not sufficient (below 4.0 V) • The main battery or external power supply is not sufficient (below 7.0 V) • The memory is full 	<p>The SeaFET V2 batteries and memory are ready to deploy, but the instrument has not received a sampling command.</p> <p>Connect the SeaFET to a computer and click on "Start" in UCI, or send "startnow" or "startlater" before deploying.</p>	<p>The SeaFET V2 batteries and memory are ready to deploy, and the SeaFET V2 has received the "startnow" or "startlater" command.</p> <p>It is either sampling or waiting to begin sampling at the time predetermined in UCI or with the "startdatetime=mmddyyhhmmss" command.</p>

If the LED does not flash, verify that fresh batteries are installed and the memory has been initialized. Engaging the magnetic switch does not change any settings on the SeaFET V2.

Batteries

Power consumption of the SeaFET V2 is lower than the SeaFET V1, allowing for longer deployment times. Specifically, the continuously powered isolated supply is no longer limited to 600 days. A new deployment endurance calculator is built into the UCI software. Use the Deployment Wizard within UCI to estimate the amount of time that the SeaFET V2's batteries will last in the field.

Powering an External Pump

If connecting an external pump, the maximum current available from the SeaFET is 650mA if the main voltage supply (internal batteries or external power supply) is between 12V-18V. If the main voltage supply is between 6V-11V, the SeaFET is limited to providing 300mA.

Sampling

The SeaFET V2 no longer utilizes burst sampling and sample averaging. Instead, autonomous and polled sampling are identical to standard Sea-Bird moored CTDs, where the instrument collects a single sample per sample interval.

- Autonomous sampling: the user programs a sample interval between 10-21600 seconds. When prompted to begin sampling via UCI or with the “**startnow**” command, the SeaFET V2 will wake, collect a single sample, then return to quiescent state.
- Polled sampling: sending a polled sampling command (such as “**TS**”) to the SeaFET V2 via RS-232 will prompt it to collect and output a sample.

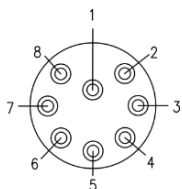
Commands

The SeaFET V2 has a completely revised command set that shares commands with standard Sea-Bird CTDs. When interfacing with the SeaFET V2 via a terminal, each line is either preceded by an S> prompt or concluded with an <Executed/> tag. **None of the original SeaFET V1 commands are valid on the SeaFET V2.** See the *Terminal Commands* section for a complete list of valid SeaFET V2 commands.

Connecting the SeaFET V2 to a Computer

The RS-232 cable used to connect the SeaFET V1 to a serial port is compatible with the SeaFET V2. **The USB cable is NOT compatible with the SeaFET V2.**

MCIL 8-MP Bulkhead Connector



Pin	Name	Description
1	VIN	External DC Power Supply, 6 – 18 Vdc
2	V-/SG	Power Supply Return / Signal Ground
3	N/A	N/A
4	CTD/PUMP V+	Optional CTD or Pump Power (12V 650mA)
5	TXD / D+	RS-232 Transmit
6	RXD / D-	RS-232 Receive
7	CTD TXD	Optional CTD RS-232 Transmit
8	CTD RXD	Optional CTD RS-232 Receive

Connect the SeaFET V2 to UCI or a terminal emulator program (such as Tera Term)

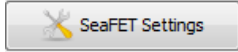
- Baud rate: default 19200
- Data: 8 bit
- Parity: none
- Stop: 1 bit
- Flow control: none

Communicating with the SeaFET V2 in UCI

UCI provides a set of tools for configuring the SeaFET V2 for deployment and processing data.

Note: Connecting to UCI will automatically set the data output format to “Converted Engineering Data in Decimal Format” (outputformat=1).

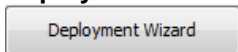
SeaFET Settings



Allows the user to change the following options:

- Sample interval
- Enable/Disable Real-time output
- Baud Rate
- Pump Duration
- Enable/Disable Powering the CTD via the SeaFET V2’s power supply (SeapHOx only)

Deployment Wizard



Allows the user to prepare the SeaFET for deployment, setting the following options:

- Sampling mode (autonomous or polled)
- Enable/Disable Real-time output
- Set the instrument’s time
- Calculate an estimated battery endurance
- Generate a PDF report of the pre-deployment settings

Start Logging



Commands the SeaFET to begin logging, or waiting to begin logging as dictated by a delayed start time from the Deployment Wizard.

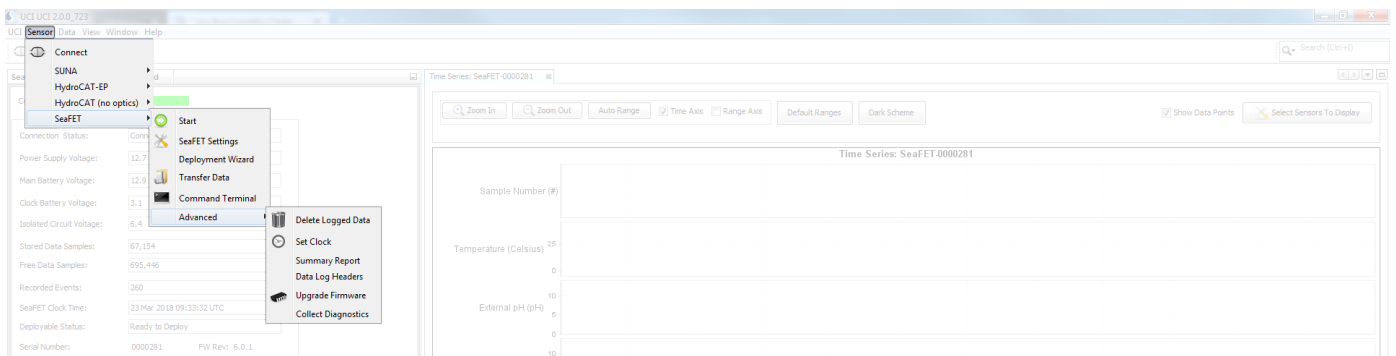
Transfer Data



Uploads data from the SeaFET V2. See “**Uploading Data from the SeaFET V2**” below.

Upgrade Firmware

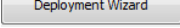
Allows users to easily upgrade the SeaFET V2’s firmware when new versions are released by Sea-Bird. In UCI, navigate to SeaFET → Advanced → Upgrade Firmware



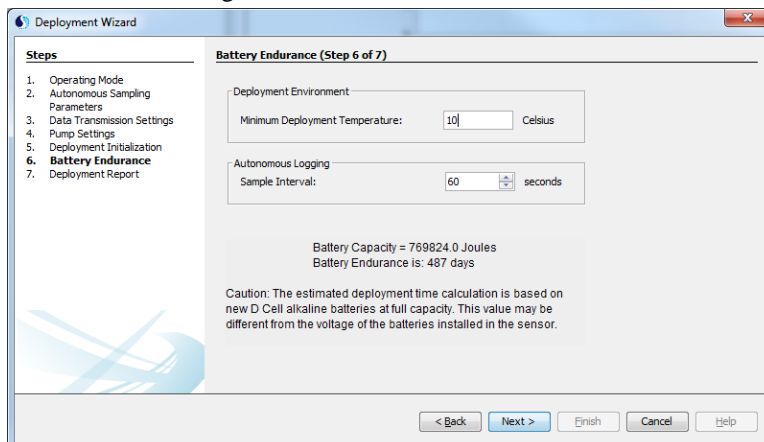
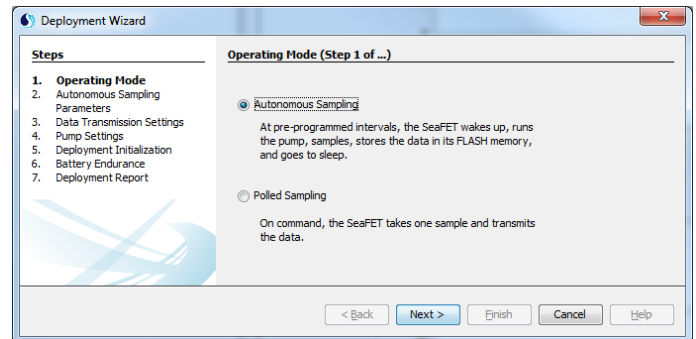
The SeaFET V2 must be configured to communicate at 19200 baud before upgrading firmware. The Firmware upgrade process can take several minutes. Do not disconnect the SeaFET from the computer or remove power during this process.

Preparing the SeaFET V2 for Deployment in UCI

Note: to start logging immediately, click “Start” in UCI or send “**Startnow**” from a terminal. If necessary, configure the SeaFET V2 in “SeaFET Settings” prior to sampling.

To begin a delayed autonomous logging routine or polled sampling routine, click on  in UCI to access the Deployment Wizard menu.

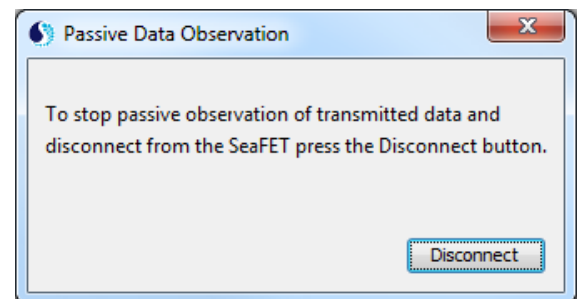
1. Determine the Operating Mode for the deployment.
 - a. Autonomous Sampling: configure the SeaFET V2 to begin sampling autonomously at a predetermined date and time.
 - b. Polled Sampling: review the SeaFET settings prior to deploying with an external controller.
2. Determine the logging start date and time (Autonomous Sampling only).
 - a. NOTE: If the SeaFET V2 Clock Time is incorrect, exit the Deployment Wizard and navigate to **Sensor** → **SeaFET** → **Advanced** → **Set Clock**.
3. Select whether to transmit data in real-time when the SeaFET V2 collects a sample, for logging to an external data logger. This consumes a small amount of additional power per sample (Autonomous Sampling only).
4. Configure the pump settings.
5. If necessary, set the SeaFET V2’s clock and decide whether to erase data currently on the memory.
6. Enter the sample interval and estimated temperature. UCI will automatically calculate an estimated deployment endurance, assuming a fresh set of batteries.



7. Generate a final Deployment Report. After finishing the Deployment Wizard, UCI will create a PDF file that contains the SeaFET V2’s deployment settings.

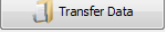
Completing the Deployment Wizard will automatically configure the SeaFET V2 with the desired settings. If configuring for Autonomous Operation, UCI will automatically send “**startlater**”, commanding the SeaFET to begin waiting to sample and disconnecting it from UCI.

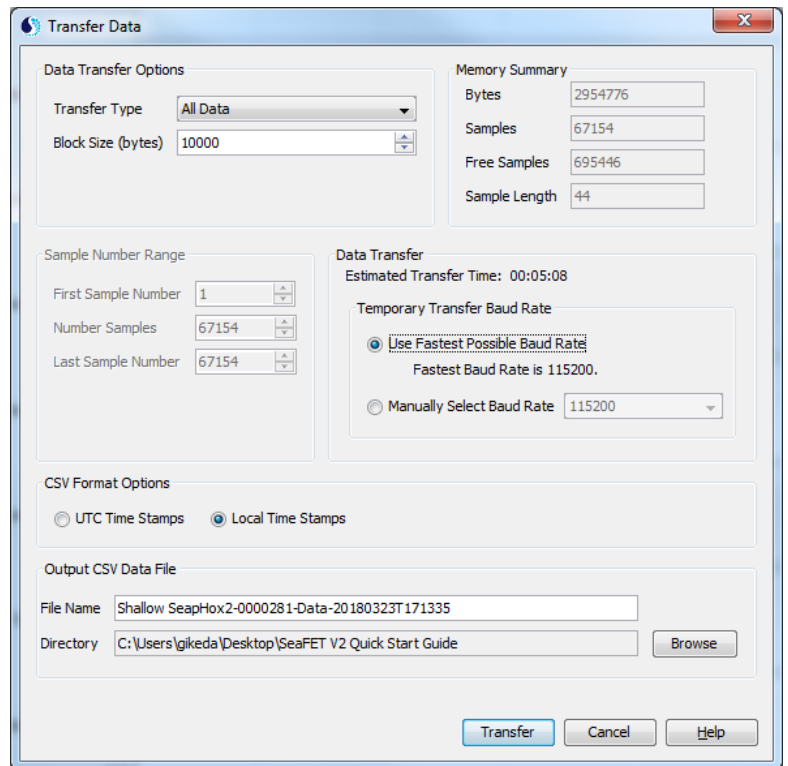
- UCI will now passively wait for SeaFET V2 data. If a sample arrives, it will appear as a data point in UCI’s Time Series plots. Click on the “Disconnect” button to stop UCI from monitoring- the SeaFET V2 will still log data to the memory.
- Reconnecting to UCI will command the SeaFET V2 to stop logging. To resume logging, rerun the Deployment Wizard or click “Start” to begin logging immediately.
- Use the magnetic switch to determine if the SeaFET V2 is sampling- a green flash indicates that the instrument is sampling or waiting to start sampling.



Uploading Data from the SeaFET V2

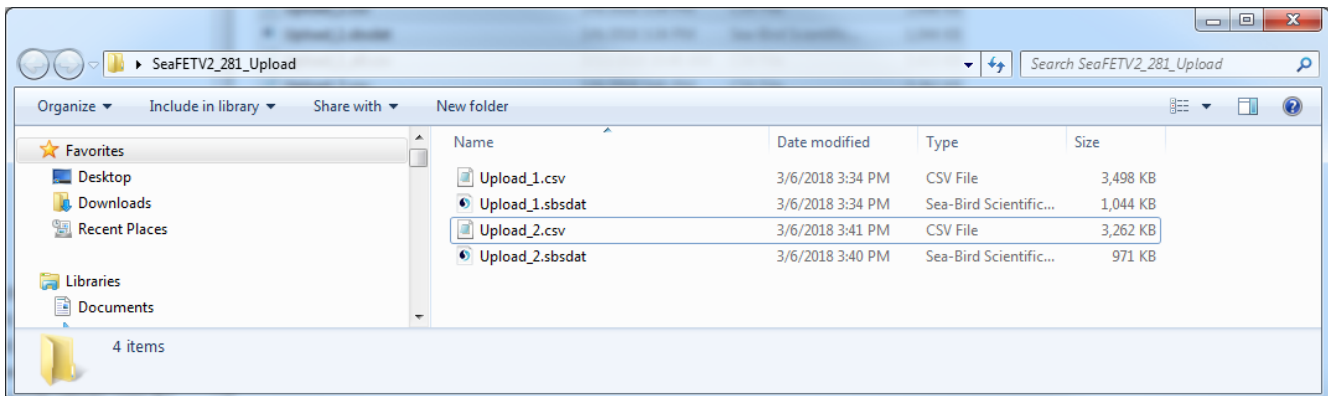
Data transfers are most efficient in UCI. When connected to a SeaFET V2, click on the “Transfer Data” button. UCI allows the user to select how much data to transfer, determine the time stamp (UTC or Local Time), and dictate the uploaded file’s name and destination.

1. Push  in the SeaFET Dashboard. UCI determines the fastest baud rate for serial data transfer and the Data Transfer Window Appears.
2. “**Data Transfer Options**” allow the user to choose between uploading all data in a single file, or uploading a range of data (as specified in the “Sample Number Range”)
3. “**Data Transfer**” allows the user to select the baud rate for data uploads. UCI can temporarily increase the SeaFET V2’s baud rate to upload data more quickly. It will revert to the previous baud rate after uploading data.
4. “**CSV Format Options**” allow the user to specify the instrument’s time stamp for Local or UTC time.
5. “**Output CSV Data File**” allows the user to specify the name and file path of the resulting .csv file.
6. Push “Transfer” to upload the data to the computer



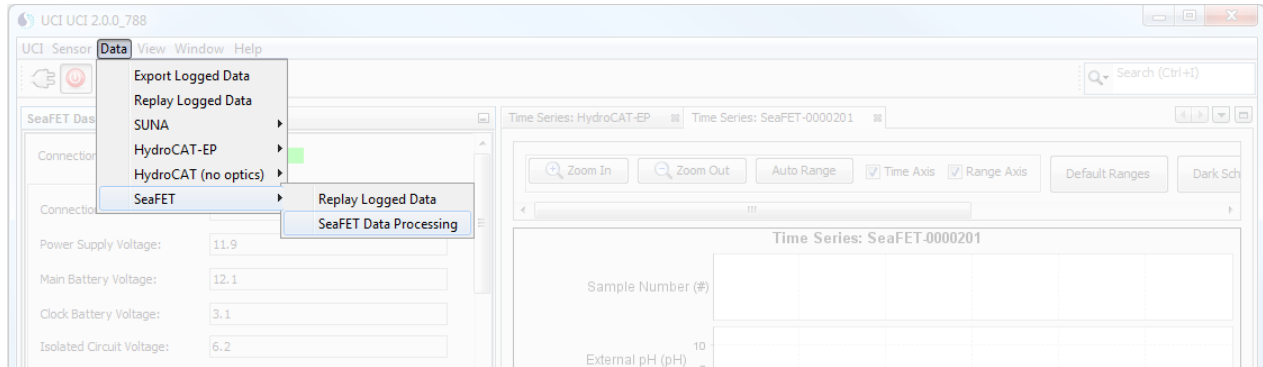
Alternatively, users can manually upload data in ASCII format with the command “**getsamples:b,e**”, where b=the starting sample number and e=the ending sample number (eg, getsamples:1,500 will upload samples 1-500). The SeaFET V2 will upload data in the format as specified by “**outputformat=x**” command. The **getsamples:b,e** is limited to uploading a maximum of 5000 samples at a time, and uploads data significantly more slowly than UCI.

UCI uploads SeaFET V2 data in binary format to create a raw data file (.sbsdat extension), then automatically converts it to a .csv file with converted data and column headers. Users can reprocess the raw .sbsdat file with new calibration/CTD data in UCI. Navigate to **Data** → **SeaFET** → **SeaFET Data Processing**.



Processing pH Data in UCI

UCI can process raw .sbsdat files uploaded from the SeaFET V2, allowing users to apply temperature and salinity corrections to obtain more accurate pH data. Navigate to the **Data** → **SeaFET** → **SeaFET Data Processing** to access the *SeaFET Data Processing* dashboard:



The user can apply temperature and salinity data to calculate a more accurate pH value than the standalone SeaFET V2 sensor, which uses an internal thermistor and a fixed salinity value.

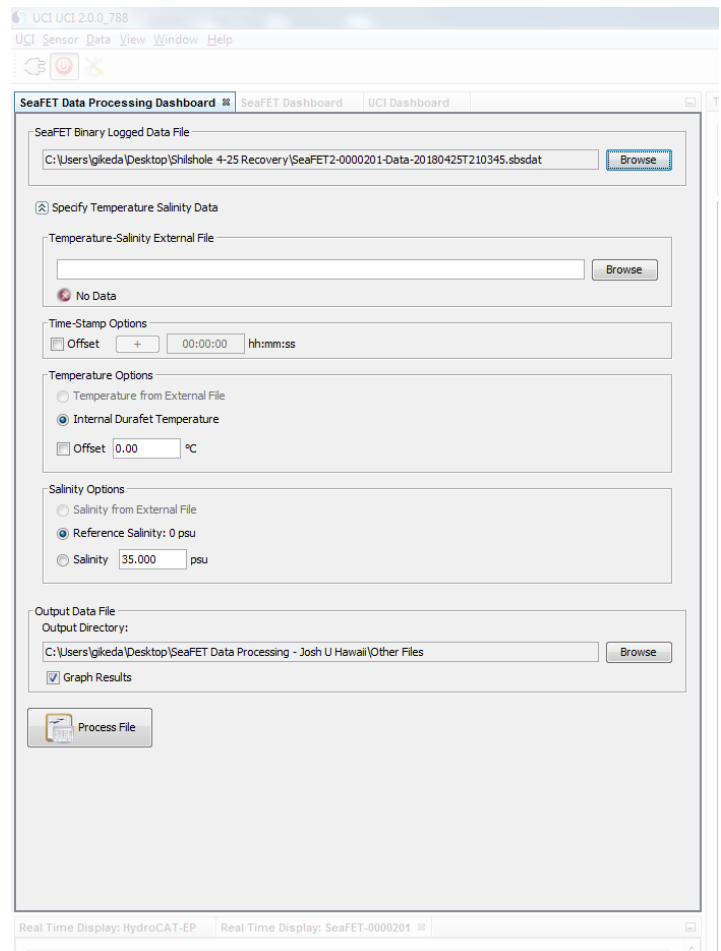
1. Press “Browse” and select a raw .sbsdat data file under “SeaFET Binary Logged Data File”
 - a. Multiple files can be processed by holding the Ctrl key while selecting .sbsdata files.
2. Click on the arrow to the left of “Specify Temperature Salinity data” to open the menu.
3. If available, upload an external file containing temperature and salinity data in one of the following formats:
 - a. A generic .CSV format:
 YYYY-MM-DD hh:mm:ss, <temperature>,

 <salinity><CR><LF>
 where:
 - Date and time in UTC
 - Temperature in C°
 - Salinity in PSU
 - <CR><LF> is the carriage return and line feed that is the end of each line.

Example:
 2013-04-25 15:22:48, 10.8326,34.8974

- b. A Sea-Bird Electronics .CNV format as made from *SBE Data Processing* with the following output variables:
 - Time, sensor (seconds)
 - Temperature (degrees C)
 - Salinity, practical (PSU)

Example:
 388682568 10.8326 34.8974 0.000e+00



If an external file is not available, the user can use the internal DuraFET temperature already recorded to the SeaFET V2 memory and specify a static salinity value to apply to the SeaFET V2’s External pH values.

Storage, Maintenance, and Deployment

Storage

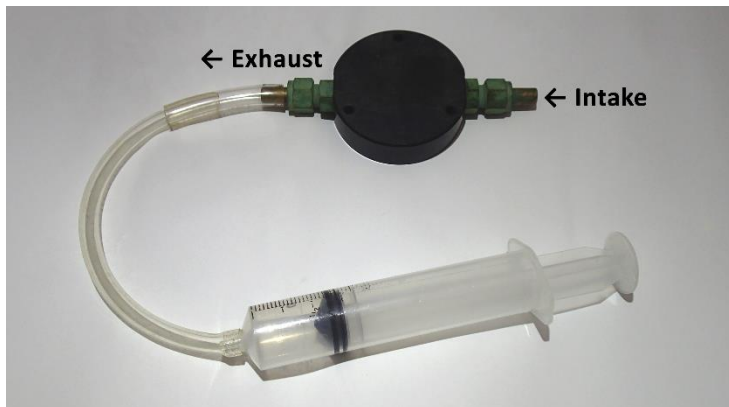
The sensors on the Shallow SeaFET V2 and SeapHOx V2 require storage in seawater. If left dry for an extended period (usually >15 minutes), the DuraFET sensor can desiccate, requiring a complete factory replacement and recalibration. Sea-Bird ships the Shallow SeaFET V2 and SeapHOx V2 with sterile seawater in the flow cell, sealed with plastic plugs. **Immediately after recovering the SeaFET V2, fill the flow cell with clean seawater and seal with the plastic plugs.** Failure to do so will cause irreversible damage to the sensors. Note that freshwater and artificial seawater are not appropriate storage mediums and will cause rapid drift of the SeaFET V2's sensors—filtered seawater is the best storage option.

Store the Deep SeapHOx V2 dry. Unlike the Shallow SeaFET V2/SeapHOx V2, the Deep SeapHOx V2 does not have a DuraFET that requires storage in seawater. Storing the sensors dry will help prevent biofouling during storage.

Deployment

The External Reference requires 24-72 hours to condition to the deployment site's seawater before providing optimal data. If possible, store the SeaFET V2's sensors in filtered seawater from the deployment site prior to deployment to reduce the conditioning time.

Bubbles on the sensors will skew data. When deploying with the flow cell and copper tubes (used for the SeapHOx deployments, and SeaFET deployments without the copper guard), Sea-Bird recommends submerging the SeaFET V2, allowing most bubbles to escape, then connecting a plastic syringe to the copper tube on the exhaust side, pushing and pulling to purge any remaining bubbles.



Pumped flow optimizes data from the SeaFET V2. If deploying as a SeaFET without a CTD, Sea-Bird recommends connecting an SBE 5M pump to the intake of the flow cell, and enabling SeaFET pump controls in UCI or a terminal emulator (usepump=y).

Cleaning

Remove biofouling with high-purity isopropyl alcohol (90% or higher), lint-free wipes, and lint-free swabs.

- **External Reference:** gently scrub with a lint-free wipe saturated in alcohol. Ensure that all alcohol has dried before storage.
- **ISFET:** gently rinse the ISFET with filtered seawater or isopropyl to remove any sediment from the face. When clear of grit that can scratch the surface, saturate a lint-free swab in alcohol, touch the face of the ISFET, and gently twist to remove any biofouling. After cleaning, the ISFET should appear flat and shiny.



Terminal Commands

CATEGORY	COMMAND	DESCRIPTION
Status	GetCD	Get and display configuration data.
	GetSD	Get and display status data.
	GetCC	Get and display calibration coefficients.
	GetEC	Get and display event counter data.
	ResetEC	Reset event counter.
	GetHD	Get and display hardware data.
	DS	Get and display status and configuration data.
	DC	Get and display calibration coefficients.
General Setup	Help	Display a list of currently active commands. Certain commands are only active in logging or non-logging modes.
	DateTime=mmddyyyyhhmmss	Set real-time clock month, day, year, hour, minute, second.
	BaudRate=x	x= Baud rate (600, 1200, 2400, 4800, 9600, 19200, 38400, 57600, or 115200). Default 19200.
	OutputExecutedTag=x	x=Y: Display XML <Executed/> tag x=N: Do not.
	TxRealTime=x	x=Y: Output real-time data while sampling autonomously. x=N: Do not.
	QS	Enter quiescent (sleep) state. Main power turned off, but data logging and memory retention unaffected.
	OutputFormat=x	x=0: Output raw decimal data. x=1: Output converted decimal data.
	Initlogging	Resets the memory pointer to sample number zero, making all memory available for logging. Must send twice to confirm.
	*Default	Reset user settings back to the defaults, as shipped from the factory.
	SampleInterval=x	x= interval (seconds) between samples (6 - 21600). When commanded to start sampling with StartNow or StartLater .
Sampling Commands	StartNow	Start logging now.
	StartLater	Start logging at delayed logging start time.
	StartDateTime=mmddyyyyhhmmss	Delayed logging start: month, day, year, hour, minute, second.
	Stop	Stop logging, or waiting to start logging if "StartLater" was sent.
	SL	Output last sample stored in the buffer.
	TS	Take sample, store data in buffer, output data, and leave power on.
	TPS	Run pump, take a sample, and output in the current output format.
	TSS	Take sample, store in buffer and in FLASH memory, output data.
	TPSS	Run pump, take sample, store in buffer and in FLASH memory, output data. Only valid if usepump=Y or in SeapHOx mode.
	Getsamples:b,e	Upload converted data samples, where b=the starting sample number and e= the ending sample number. Total must not exceed 5000 samples.
	Recoveramples	Restore the stored sample number. This can be used to restore the sample number after an "initlogging" command is sent but before any new samples are taken.
	ReferenceSalinity=x	Sets the salinity value (psu) to be used in calculations.
	Getsamples:b,e	Upload converted data samples, where b=the starting sample number and e= the ending sample number. Total must not exceed 5000 samples.

CATEGORY	COMMAND	DESCRIPTION
Pump Setup	Usepump=x	x=Y : Configure SeaFET to power an external pump. x=N : Do not use an external pump.
	Pumptime=x	x = 0-550 seconds. Sets the amount of time that the pump runs per sample. 38.5 seconds recommended
	Pumpon	Run the attached pump. Pump will automatically stop after 2 minutes. <ul style="list-style-type: none"> SeaFET: requires "usepump=1" SeapHOx: uses the SBE37's pump.
	Pumpoff	Stop the pump.
SeaFET Calibration Coefficients	phcaldate=	pH calibration date (dd-mmm-yy).
	K0=	Set K0 coefficient.
	K2=	Set K2 coefficient.
	ReferenceSalinity=	Sets the salinity value to be used in calculations.
	tdfcaldate=	DuraFET temperature calibration date (dd-mmm-yy).
	tdfa0=	Set DuraFET's thermistor temperature coefficient, A0.
	tdfa1=	Set DuraFET's thermistor temperature coefficient, A1.
	tdfa2=	Set DuraFET's thermistor temperature coefficient, A2.
tdfa3=	Set DuraFET's thermistor temperature coefficient, A3.	
SeapHOx Specific Commands	Resync	Re-synchronize the host SeaFET to the SBE 37-SMP-ODO. Communicates with the 37 to configure the CTD and download coefficients and serial numbers from the attached SBE37 and SBE63.
	Send37=x	Send a command directly to the attached SBE37. x = command for the SBE 37.
	Ctdpower=	Configures the SeapHOx to provide power to the attached SBE37. Power is sourced from the current voltage supply, which can be the internal batteries or external power. x=0 : Do not power the SBE 37 x=1 : Power the SBE 37
	Setoxunits=x	x=0 : Display oxygen units in ml/L x=1 : Display oxygen units in mg/L
	Usectdt=x	x=0 : Use DuraFET temperature for calculations. x=1 : Use CTD temperature value for calculations.

Note: Sending the “**help**” command will display a list of SeaFET V2 commands. If the instrument is sampling (**startnow**) or waiting to start sampling (**startlater**), sending “**help**” will display a subset of commands that are active while sampling.

SeaFET Data Formats

Each scan ends with a carriage return <CR> and line feed <LF>. Spaces have been replaced with a · character in the examples below to demonstrate the length of the output format.

OutputFormat=0: Raw Data in decimal format, for diagnostic use at Sea-Bird

- FrameSync
- Timestamp
- Data Error Flags
- Temperature
- Vrs_ext
- Vrs_int
- pH Temperature
- Vk
- Ib
- Ik
- Internal Relative Humidity
- Internal Temperature

Example: Sample data output when **OutputFormat=0:**

```
SEAFET00201,2018-05-01T08:20:33,·0000,·5189166,·4989334,··972849,·6043289,·8379635,·8384892,·26208,·28824
```

OutputFormat=1: Converted Engineering data in decimal format

- FrameSync
- Timestamp
- Sample Number
- Data Error Flag
- pH External
- pH Internal
- Vrs_ext
- Vrs_int (DuraFET·only)
- pH Temperature (DuraFET·only)
- Internal Relative Humidity
- Internal Temperature

Example: Sample data output when **OutputFormat=1:**

```
SEAFET00281,2018-05-01T08:24:28,·····10,·0000,6.9227,6.8275,-0.936386,-0.993090,·23.1636,·42.2,23.7
```

SeapHOx Data Formats

Each scan ends with a carriage return <CR> and line feed <LF>. Spaces have been replaced with a · character in the examples below to demonstrate the length of the output format.

OutputFormat=0: Raw Data in decimal format, for diagnostic use at Sea-Bird

- FrameSync
- Timestamp
- Data Error Flags
- Temperature
- Vrs_ext
- Vrs_int
- pH Temperature
- Vk
- Ib
- Ik
- Pressure
- Pressure Temperature
- Conductivity
- Oxygen phase
- Oxygen Temperature
- Internal Relative Humidity
- Internal Temperature

Example: Sample data output when **OutputFormat=0:**

```
SSPHOX00281,2018-05-01T07:53:28,·0000,·221802,·5246643,·5056437,·972651,·5054727,·8380859,·8386792,·525545,·2728,·2673.191,·16.826,·0.583125,·26288,·25420
```

OutputFormat=1: Converted Engineering data in decimal format

- FrameSync
- Timestamp
- Sample Number
- Data Error Flag
- Temperature
- pH External
- pH Internal
- Vrs_ext
- Vrs_int
- pH Temperature (DuraFET thermistor)
- Pressure
- Salinity
- Conductivity
- Oxygen
- Internal Relative Humidity
- Internal Temperature

Example: Sample data output when **OutputFormat=1:**

```
SSPHOX00281,2018-05-01T07:50:23,····10,·0000,·23.1361,4.9494,6.8283,-0.936374,-0.993053,·23.1114,····0.074,···0.1646,··0.03289,··5.741,·42.3,23.6
```

Deep SeapHOx Data Formats

Each scan ends with a carriage return <CR> and line feed <LF>. Spaces have been replaced with a · character in the examples below to demonstrate the length of the output format.

OutputFormat=0: Raw Data in decimal format, for diagnostic use at Sea-Bird

- FrameSync
- Timestamp
- Data Error Flags
- Temperature
- Vrs_ext
- Vk
- Ib
- Ik
- Pressure
- Pressure Temperature
- Conductivity
- Oxygen phase
- Oxygen Temperature
- Internal Relative Humidity
- Internal Temperature

Example: Sample data output when **OutputFormat=0:**

```
DSPHOX00001,2018-04-18T16:19:22,·0011,·····0,·4987386,·5393555,·8380480,·8386154,·673054720,·····2,·7680000.000,·916.679,·-0.213566,·26380,·21936
```

OutputFormat=1: Converted Engineering data in decimal format

1. FrameSync
2. Timestamp
3. Sample Number
4. Data Error Flag
5. Temperature
6. pH External
7. Vrs_ext
8. Pressure
9. Salinity
10. Conductivity
11. Oxygen
12. Internal Relative Humidity
13. Internal Temperature

Example: Sample data output when **OutputFormat=1:**

```
DSPHOX00001,2018-05-01T07:50:23,·····10,·0000,·23.1361,4.9494,-0.936374,····-0.074,···0.1646,··0.03289,··5.741,·42.3,23.6
```