



SEA-BIRD
SCIENTIFIC

User manual

ECO V2

Environmental Characterization Optics V2

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Section 1 Safety information

Please read this entire manual before this equipment is unpacked, set up, or operated. Pay attention to all danger, warning, and caution statements. Failure to do so could result in serious injury to the operator or damage to the equipment.

DANGER

Indicates a potentially or imminently hazardous situation which, if not avoided, will result in death or serious injury.

WARNING

Indicates a potentially or imminently hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION

Indicates a potentially hazardous situation that may result in minor or moderate injury.

NOTICE

Indicates a situation which, if not avoided, may cause damage to equipment. Information that requires special emphasis.

1.1 Hazard information

WARNING

This product can expose the user to chemicals with silica, crystalline (airborne particles of respirable size), which is known to the State of California to cause cancer and birth defects or other reproductive harm. For more information, go to www.P65Warnings.ca.gov.

WARNING



If the user thinks that a sensor has water in the pressure housing: Disconnect the sensor from any power supply. Put on safety glasses and make sure that the sensor is pointed away from the body and other people. In a well ventilated area, use the purge port (if the sensor is so equipped), or very SLOWLY loosen the bulkhead connector to let the pressure release.

WARNING





Sensors that use ultraviolet light sources (< 400 nm): Do not look directly at a UV light source when it is on. It can cause damage to the eyes. Keep products that have UV light sources away from children, pets, and other living organisms. Wear polycarbonate UV-resistant safety glasses to protect the eyes when a UV light is on.

WARNING






If the user thinks that the batteries have leaks, pressure may have built up inside of the pressure housing. Follow ESD protocols to release internal pressure. Put on safety glasses and protective gloves and make sure that the sensor is pointed away from the body and other people. In a well ventilated area, very SLOWLY loosen the bulkhead connector to release the pressure. Keep away from heat, sparks, flame, and other sources of ignition. Do not smoke.

⚠ CAUTION	
 	<p>The pressure housing contains Electrostatic Discharge (ESD) sensitive parts and assemblies that are susceptible to damage from ESD. Follow ESD protocols:</p> <ul style="list-style-type: none"> • Put on protective eye wear before you open the pressure housing. • Any electrostatic charge on the body of the human operator must be released before the pressure housing is opened: put a hand on a grounded surface, or better, wear a grounded antistatic wrist strap. • At a minimum, wear short-sleeved antistatic clothing, such as cotton, or better, wear an antistatic smock for this service activity. <i>Do not wear a sweater, fleece or polyester-based clothing.</i> • At a minimum, use a workstation with a wood or metal tabletop, or better, a tabletop that dissipates static. <i>Do not use a workstation with a synthetic or polymeric-based tabletop.</i>

NOTICE
<p>The manufacturer is not responsible for any damages due to misapplication or misuse of this product including, without limitation, direct, incidental and consequential damages, and disclaims such damages to the full extent permitted under applicable law. The user is solely responsible to identify critical application risks and install appropriate mechanisms to protect process during a possible equipment malfunction.</p>

1.2 Equipment labels

Read all labels and tags attached to the equipment. Personal injury or damage to the equipment could occur if not observed. A symbol on the equipment is referenced in the manual with a precautionary statement.

 <div style="border: 1px solid black; padding: 2px; margin-top: 5px;"> ⚠ WARNING UV LIGHT. Do not look directly at light. </div>	<p>Do not look directly at a UV light source when it is on. It can cause damage to the eyes. Keep products that have UV light sources away from children, pets, and other living organisms. Wear polycarbonate UV-resistant safety glasses to protect the eyes when a UV light is on.</p>
	<p>EFUP e: No hazardous material exists over the threshold of GB/T 26572-2011 standard, China's Requirements for Concentration Limits for Certain Hazardous Substances in Electrical and Electronic Products. This product should be recycled after its environmentally friendly use period.</p>
	<p>Electrical equipment marked with this symbol may not be disposed of in European domestic or public disposal systems. Return old or end-of-life equipment to the manufacturer at no charge to the user.</p>

Section 2 ECO™ V2 quick start guide

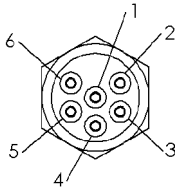
This quick start guide gives the steps necessary to set up and make sure that the ECO V2 sensor operates and collects data before it is deployed.

Delivered items—

- ECO V2 sensor
 - Twelve 3.6-volt AA-size lithium batteries (model-specific, shipped separately)
 - Dummy plug and lock collar
 - Spare parts kit (model-specific)
 - Test stick (model-specific)
 - USB drive with software and calibration or characterization information.
1. If the sensor is so-equipped, install the manufacturer-supplied batteries ([Install batteries](#) on page 11):
 - a. Remove the end flange of the sensor.
 - b. Use a 7/64" hex key to loosen the captivating screw on the end flange and disconnect the battery pack and remove it from the sensor.
 - c. Install new batteries.
 - d. Connect the battery pack to the sensor again and install the end flange again.
 2. Install the manufacturer-supplied software on a PC. ([Install and start software](#) on page 13).
 3. Verify that the sensor operates and collects data ([Verify sensor operation](#) on page 11):
 - a. Connect the sensor to the PC and start the software.
 - b. If necessary, supply external power to the sensor (models with no internal batteries).
 - c. Push **Connect** to start communication with the sensor.
 - d. Push **Start** to collect data.
 - e. Remove and replace the protective cover on the optical face several times to change the value of the collected data.
 - f. Push **Stop** to stop data collection.
 4. Verify that the sensor transmits data ([Transmit data](#) on page 21):
 - Push **Transmit Data** in the [Dashboard](#) and select "All Data" to transmit data collected by the sensor to the PC.
 - Open the file on the PC to look at the data.
 5. Use the "Deployment Wizard" in the software to set up the sensor for a specific deployment. ([Deployment wizard](#) on page 17)
 6. If necessary, attach the sensor to the frame on which it will be deployed.
 7. Make sure to do maintenance on the sensor at regular intervals. ([maintenance](#))

Section 3 Specifications

3.1 Mechanical

Contact	Function	MCBH-6-MP
1	Ground	
2	RS232 RX	
3	Analog out 1	
4	Voltage in	
5	RS232 TX	
6	Analog out 2	

3.1.1 Four optical measurements (Quad)

Depth rating	600 m	1000 m	6000 m	6000 m
Diameter	6.30 cm	8.08 cm	6.30 cm	6.30 cm
Length	13.36 cm	33.6 cm	11.49 cm	28.05 cm
Weight in air	1 kg	2 kg	1 kg	2 kg
Internal memory	Y	Y	Y	Y
Wiper + copper faceplate	N	Y	N	N
Internal batteries	N	Y	N	Y
Operation temperature range	0–30 °C			
Storage temperature range	-20–50 °C			

3.1.2 Three optical measurements (Triplet)

Depth rating	600 m	1000 m	1500 m	2000 m	6000 m
Diameter	6.30 cm	8.08 cm	8.08 cm	6.30 cm	6.30 cm
Length	13.36 cm	33.6 cm	16.84 cm	13.36 cm	11.49 cm
Weight in air	1 kg	2 kg	1 kg	1 kg	1 kg
Internal memory	Y	Y	Y	N	Y
Wiper + copper faceplate	N	Y	Y	N	N
Internal batteries	N	Y	N	N	N
Operation temperature range	0–30 °C				
Storage temperature range	-20–50 °C				

3.1.3 Two optical measurements (FLNTU)

Depth rating	300 m	600 m	2000 m	6000 m
Diameter	6.3 cm			
Length	29.78 cm	13.62 cm	13.7 cm	11.8 cm
Weight in air	2 kg	0.6 kg	0.6 kg	1 kg
Internal memory	Y	N	N	N
Wiper + copper faceplate	Y	N	N	N

Specifications

Internal batteries	Y	N	N	N
Operation temperature range	0–30 °C			
Storage temperature range	-20–50 °C			

3.1.4 One optical measurement (fluorescence or scattering)

Depth rating	300 m	300 m	600 m	600 m	6000 m
Diameter	6.30 cm	6.30 cm	6.30 cm	6.30 cm	6.30 cm
Length	29.78 cm	13.62 cm	13.67cm	13.67 cm	11.8 cm
Weight in air	2 kg	0.6 kg	0.6 kg	0.6 kg	1 kg
Internal memory	Y	Y	Y	N	N
Wiper + copper faceplate	Y	Y	N	N	N
Internal batteries	Y	N	N	N	N
Operation temperature range	0–30 °C				
Storage temperature range	-20–50 °C				

3.2 Electrical

Input	7–20 VDC
Current draw, typical	60 mA @ 12 V
Current draw, single-arm wiper	< 28.0 mA @ 12 V
Current draw, three-arm wiper	< 70.0 mA @12 V
Current draw, low power	140 µA @12 V
Linearity	99%

3.3 Optical

Parameter	Wavelength EX/EM	Range, Resolution
Chlorophyll (Chl) 435	435/695 nm	0–400, 0.016 µg/L/count
Chlorophyll (Chl) 470	470/695 nm	0–400, 0.016 µg/L/count
Fluorescent Dissolved Organic Matter (fDOM)	370/460 nm	0–900, 0.016 ppb/count
Uranine (UR)	470/530 nm	0–400, 0.06 ppb/count
Phycoerythrin (PE) Rhodamine (RH)	530/595 nm	0–230, 0.03 ppb/count
Phycocyanin (PC)	630/680 nm	0–230, 0.03 ppb/count
Scattering	412, 440, 470, 488, 510, 530, 595, 630, 650, 676, 700, 720, 770, 780, 870, 880 nm	wavelength-dependent
Scattering, NTU	700 nm	0–350, 1.32E-03 NTU

3.4 Communication

Sample rate	user-selectable to 8 Hz (default: 1 Hz)	
Data storage	Single measurement: 1048000 samples; Dual measurement: 762000 samples;	Triplet measurement: 599000 samples; Quad measurement: 493000 samples
RS232 output rate	user-selectable, default: 19200 baud	
Data resolution	16 bit	
Digital output maximum	550,000 counts	
Analog output signal	0–5 V	
Data validation	flags provided	
RMS noise	2 counts	
Instantaneous noise	±5 counts	
Software	UCI 4.0	

3.4.1 Sample rates

Number of channels	DataRateHz (cmd)	Ave (cmd)	RTC (hardware)	TXRealtime (cmd)	DataRateHz Range (sample rate, Hz)	OutStr setting (cmd)
One-channel						
1	NA	1–35	No	NA	1.0–13.8	OutStr=0,9,31,33,195
1	1-8	NA	No	NA	2–8	
1	NA	1–35	Yes	Yes	0.99–12.7	OutStr=0,3,7,31,33,195
1	1-8	NA	Yes	Yes	1–8	
1	NA	1-35	Yes	No	1.0–19.8	
1	1-8	NA	Yes	No	1-8	
Two-channel						
2	NA	1-35	No	NA	0.51-9.2	OutStr= 0,9,31,33,56,58,195
2	1-8	NA	No	NA	1-8	
2	NA	1-35	Yes	Yes	0.51–8.7	OutStr=0,3,7,31,33,56,58,195
2	1-8	NA	Yes	Yes	1-8	
2	NA	1–35	Yes	No	0.52-12.7	
2	1-8	NA	Yes	No	1-8	
Three-channel						
3	NA	1-35	No	NA	0.34-6.8	OutStr=0,9,31,33,56,58,81,83,195
3	1-8	NA	No	NA	1-6	
3	NA	1-35	Yes	Yes	0.34–6.6	OutStr=0,3,7,31,33,56,58,81,84,195
3	1-8	NA	Yes	Yes	1-6	
3	NA	1	Yes	No	0.35–9.3	
3	1-8	NA	Yes	No	1-8	

Specifications

Four-channel						
4	NA	1-35	No	NA	0.26–5.5	OutStr=0,9,31,33,56,58,81,83,106,108,195
4	1-8	NA	No	NA	1-5	
4	NA	1-35	Yes	Yes	0.26-5.3	Outstr=0,3,7,31,33,56,58,81,83,106,108,195
4	1-8	NA	Yes	No	1-5	
4	NA	1	Yes	No	0.26-7.4	
4	1-8	NA	Yes	No	1-7	

Notes

- Sample timing measurements used the **OutStr** value shown in the table above. If the user changes the **OutStr**, the permitted sample rates and timing will be affected.
- For highly accurate sample timing, use the DataRateHz command. The "Ave" command is available to configure sample rates to non-integer values. If the ECO V2 is configured this way, it will create an offset error between the reported sample rate and the actual sample rate. The timing error is a constant offset in the sample rate, but the rate of error will not change while data is collected, so the sensor will have a deterministic sample interval.
- An ideal sample would take the average of more than 1 sample, but ECO V2 lets the user enter Ave=1. If this value is used, the actual sample rate may be up to 50% faster than the reported value. This reported error comes from conservative timing limits and optimization routines designed for routines where Ave > 1.
- If the sample rate is set to Ave=33, the actual rate may be up to 10% faster than the reported value.
- When data is collected with txrealtime enabled, or an ECO V2 with no memory is used, the OutStr value and BaudRate affect the sample timing.
- Sensors without memory/RTC have samples rates that will change by approximately ± 1 Hz with temperature.

Setup: ECO V2 with firmware version 3.10.1b7626

Wiper timing:






Single-arm wiper—nominal time for a single wipe is 2.7 seconds

Three-arm wiper—nominal time for a single wipe is 1.4 seconds



Section 4 Verify sensor operation

Make sure the sensor operates, collects, and transmits data and then set up the sensor for deployment.

4.1 Install batteries

⚠ WARNING	
	Explosion hazard. If the batteries are not installed correctly, explosive gases can be released. Make sure that the batteries are of the same approved chemical type and are inserted in the correct orientation.
⚠ WARNING	
	If the user thinks that a sensor has water in the pressure housing: Disconnect the sensor from any power supply. Put on safety glasses and make sure that the sensor is pointed away from the body and other people. In a well ventilated area, use the purge port (if the sensor is so equipped), or very SLOWLY loosen the bulkhead connector to let the pressure release.
⚠ WARNING	
	If the user thinks that the batteries have leaks, pressure may have built up inside of the pressure housing. Follow ESD protocols to release internal pressure. Put on safety glasses and protective gloves and make sure that the sensor is pointed away from the body and other people. In a well ventilated area, very SLOWLY loosen the bulkhead connector to release the pressure. Keep away from heat, sparks, flame, and other sources of ignition. Do not smoke.
⚠ CAUTION	
 	<p>The pressure housing contains Electrostatic Discharge (ESD) sensitive parts and assemblies that are susceptible to damage from ESD. Follow ESD protocols:</p> <ul style="list-style-type: none"> • Put on protective eye wear before you open the pressure housing. • Any electrostatic charge on the body of the human operator must be released before the pressure housing is opened: put a hand on a grounded surface, or better, wear a grounded antistatic wrist strap. • At a minimum, wear short-sleeved antistatic clothing, such as cotton, or better, wear an antistatic smock for this service activity. <i>Do not wear a sweater, fleece or polyester-based clothing.</i> • At a minimum, use a workstation with a wood or metal tabletop, or better, a tabletop that dissipates static. <i>Do not use a workstation with a synthetic or polymeric-based tabletop.</i>

The manufacturer ships the 12 lithium batteries for the sensor separately. Do the steps below to install or replace the batteries. Also see the "how to" video on the manufacturer's website to do this procedure.

	
Do not ship assembled battery packs	Lithium batteries are packaged in heat-sealed plastic and bubble-wrap.

Verify sensor operation

Table 1 Recommended lithium battery brands

SAFT LS-14500 (included)	3.6 V, 2.6 Ah
Tadiran TL-4903	3.6 V, 2.4 Ah
Electrochem BCX85 series	3.9 V, 2.0 Ah

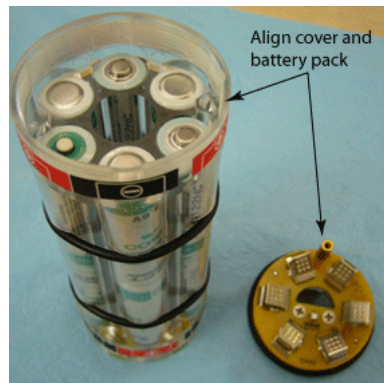
1. Make sure that the end flange and pressure housing are dry.
2. Use a 9/64" hex key to remove the two screws on the sides of the pressure housing.
3. Install these two screws into the sides of the end flange to start to loosen the end flange.



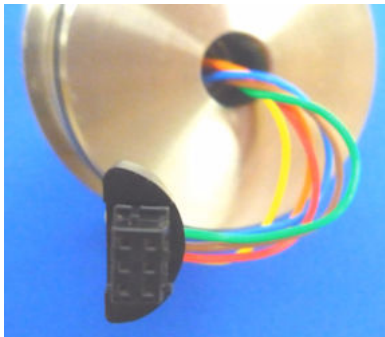
4. Turn the end flange counter-clockwise to loosen it from the pressure housing.
5. Pull gently to disconnect the battery wires in the end flange from the battery pack.
6. Use a lint-free tissue to remove any water from the O-ring surfaces inside the pressure housing and end flange.
7. Use a 7/64" hex key to loosen the captured screw in the battery cover plate.
8. Remove the battery pack from the pressure housing.
9. Turn the yellow cover plate counterclockwise to remove it from the battery pack body.
10. Move each of the two O-rings on the outside of the battery holder from the grooves. It makes it easier to remove or insert batteries.



11. If necessary, remove the size AA batteries in the pack.
12. Insert new batteries.
Make sure to alternate the positive (+) and the negative (-) ends on the size AA batteries to agree with the labels on the pack as they are installed.
13. Move the O-rings back into the grooves.
14. Align the pin on the yellow battery cover with the post hole in the battery pack assembly.



15. Align the "D"-shaped part of the battery pack with the pins on the shaft.
16. Slowly move the assembly onto the housing. Push gently to connect the battery assembly with the circuit board in the pressure housing.
17. Use a 7/64" hex key to tighten the captured screw on the yellow battery cover onto the shaft in the pressure housing.
18. Attach the Molex connector on the end flange to the connector in the pressure housing.



19. Examine the O-rings on the end flange. They must be pristine, with no lint or scratches or chips.
 - Apply a small quantity of Parker Super O Lube® to any new O-rings.
20. Align the end flange holes with the holes in the pressure housing.
21. Carefully push the end flange into the pressure housing.
It may help to rotate the end flange so that the wires do not bend too much.
22. If necessary, use a 9/64" hex key to remove the two screws from the end flange.
23. Use a 9/64" hex key to install the two screws into the pressure housing of the sensor again.

4.2 Install and start software

Install the manufacturer-supplied software and make sure that the sensor is ready to test for functionality before configuration and deployment. If the sensor is so equipped, install the batteries if necessary. The manufacturer-supplied UCI software communicates with a number of sensors. The sensors that are supported are listed in the **Sensor** menu of the software.

1. Get the software from the manufacturer's website or the manufacturer-supplied USB drive.
2. Install the appropriate software.
 - a. For Windows®: Double-click on the file with ".exe" appended to the name.

- b. For Mac OS X®: Double-click on the file with ".pkg" appended to the name. Make sure that the default "Install for all users on this computer" is selected as the destination for the installed software. If "Install for me only" or "Install on a specific disk" is selected, the software will not connect to the sensor.
3. Push **Run** in the new window.
The setup wizard starts.

4.3 Verify operation

Do the steps below to make sure the sensor operates, collects, and stores data before further setup and deployment. Note that the sensor collects and stores (if equipped with memory) all available parameters. The user can use the software to see a subset of the collected data. Refer to [Output description](#) on page 19 for an example of the data that the sensor collects.

1. Connect the test cable to the sensor, the PC, and a regulated power supply set at 12 V.
2. If necessary, start the software.
3. If necessary, go to the **UCI** menu, then **Preferences** to look at or change the directory in which collected data will be stored.
4. Push **OK** to save any changes, or **Cancel** if no changes were made to the "Default Data Directory."
5. Push **Connect** in the Dashboard area or from the **Sensor** menu item at the top of the UCI window.
Refer to [Sensor dashboards](#) on page 39 for details about the Dashboard area.
6. If necessary, change the "Instrument Type" to agree with the connected sensor.
7. Put a check in the "Try All Baud Rates" box.
The software automatically finds the correct baud rate.
8. Push **Connect**.
The "Connection Mode" turns yellow, then green and the Mode changes to "Setup."
9. Push **Get ECO V2 Settings** in the Dashboard area of the connected sensor to look at the parameters that will show in the output.
The *Output Format* tab shows. The basic output parameters are FrameSync, Header, Time and Date, and engineering units for each of the channel(s) of the sensor.
10. Push **Cancel**.
Refer to [Autonomous operation](#) on page 17 for details to change the Output Format settings.
11. In the *Samples* tab, put a check in the box next to "Sample Continuously" or set a time interval between samples.
12. In the *Transmit Data* tab, put a check in the box for the sensor to transmit data in real time to an externally connected logger or controller.
The default serial baud rate, typically 19200, is supplied by the software and does not need to be changed.
13. Push **Apply** to store the settings in the sensor.
14. Push **Select Sensors** in the *Time Series* graph.
15. Put a check in the box next to any additional parameters, so that they will show in the *Time Series* graph.
16. Push **Start** in the Dashboard area or use the Start icon (green circle with a white arrow) under the UCI menu options.
The sensor collects data and stores it in the ECO V2. A *Data Collection* tab shows so the user can choose **Start Save to File** so that the collected data is also saved to the PC to look at before it is transmitted from the memory of the ECO V2. Change the location to which the data is saved if necessary, or close the window.

17. Let the sensor collect data for several minutes.
18. Push **Stop** in the Dashboard or use the icon under the UCI menu options.
The "Connection Mode" shows "Setup."
19. Optional: push **Disconnect** to disconnect the ECO V2.
20. Go to the directory on the PC in which the data was saved to see the collected data.

Section 5 Deployment and recovery

5.1 Deployment wizard

Use the deployment wizard in the UCI software to set up the sensor for either autonomous or polled (controlled) operation.

To start the deployment wizard, go to either the **Sensor** menu or push **Deployment Wizard** in the dashboard for the sensor.

5.1.1 Autonomous operation

1. Start the software if necessary.
2. Push **Deployment Wizard** in the dashboard of the connected sensor.
3. Select autonomous operation. Push **Next**.
4. Select the way data is transmitted from the sensor:
 - a. Put a check at "Transmit Data in Real Time" to see data in a connected controller or PC as it is collected.
Note that if this is turned off, power consumption is reduced and the battery life is extended.
 - b. Push **Modify Format** to change the parameters that are transmitted from the sensor.
 - "Field Format" is "Variable" or "Fixed."
 - "Field Delimiter" is "Tab" or "Comma" or "Space."
 - "Enable Checksum" enables a value at the end of each line of data, used by the software to determine if there are data transmission errors.
 - Select the desired output parameters from the applicable type of sensor at the *FDOM*, *CHL*, *Backscattering-530*, *Instrument*, and *Backscattering-700* tabs.
 - c. Push **Next** when complete, or if no changes are necessary. Refer to [Output description](#) on page 19 for details about each parameter.
5. Select the frequency and interval of data collection:
 - a. Select a data rate: 1 Hz is the default of one sample/second.
 - b. Put a check in the box at "Sample Continuously" so that the sensor operates continuously at the selected data rate, **or**
 - c. Remove the check and select the "Cycle Start Interval."
 - d. "Number of samples per Cycle": Enter a value of 1–86400.
 - e. "Number of cycles": enter a value of 0–65535.
 - f. Push **Next**.
6. Set the clock used by the sensor:
 - a. Push **Synchronize ECO V2 clock to computer**.
 - b. To erase the data stored in the sensor and set the event counters to 0, put a check in the box.
7. Enter the date and time for the sensor to start data collection.
8. Battery endurance calculator:
 - a. The information in the *Instrument* tab is set by the manufacturer.
 - b. Use the manufacturer-supplied batteries and enter the "Minimum Deployment Temperature" in the *Environment* tab.
 - c. The software helps the user calculate the life of other brands and types of batteries.
 - d. Push **Next**.
9. Optional: make a deployment report:
 - a. Enter any information to be added to the deployment report.

- b. Push **Browse** to set the location on the PC to which the report will be saved.
 - c. The report will show on the PC if there is a check in the box at "View Report."
10. Push **Finish** to close the Deployment Wizard.
11. The sensor will start data collection at the user-specified date and time.

5.1.2 Polled operation

1. Start the software if necessary.
2. Push **Deployment Wizard** in the dashboard of the connected sensor.
3. Select polled operation. Push **Next**.
4. Push **Modify Format** to change the parameters that are transmitted from the sensor, or push **Next**. Refer to [Output description](#) on page 19 for details about each parameter.
5. Set the clock used by the sensor:
 - a. Push **Synchronize ECO V2 clock to computer**.
 - b. To erase the data stored in the sensor and set the event counters to 0, put a check in the box.
6. Select the frequency and interval of data collection:
 - a. Enter the value for "Polling Interval" to set the start time of each interval.
 - b. "Number of samples per Poll": Enter a value of 1–86400.
 - c. Select a data rate: 1 Hz is the default of one sample/second.
 - d. Push **Next**.
7. Optional: make a deployment report.
 - a. Enter any information to be added to the deployment report.
 - b. Push **Browse** to set the location on the PC to which the report will be saved.
 - c. The report will show on the PC if there is a check in the box at "View Report."
8. Push **Finish** to close the Deployment Wizard.
9. The sensor will start data collection when directed by the controller.

5.2 Recover sensor from deployment

When the deployment is complete, remove the sensor from the water and if necessary, connect it to a PC with the UCI software to turn it off. Disconnect the deployment cable, and make sure to flush the connector and sensor with fresh water. Dry the optical face of the sensor with lint-free tissues. Dry the sensor with a soft cloth or tissues. Immediately attach the protective cover for the optical face and the dummy plug and lock collar to the bulkhead connector.

Section 6 Transmit data

Data that is collected and stored by sensors must be transmitted to a PC to process the data into a human-readable format.

6.1 Output description

The sensor always collects data for all parameters for which it was built. Data is collected in binary. The UCI software converts the data into a .csv format.

The user can select which values to see as output. From the **ECO V2 Settings** window, push **Modify Format** to see the options.

Field Format

- Variable (default setting): The output fields expand according to the size of the individual output. There is only one delimiter without any extra whitespace. Each record is the minimum size for each set of data.
- Fixed: The output fields are padded with leading spaces so each output field uses the same space that a maximum value output would use. This makes each output record the same length.

Field Delimiter

- Space: data units are separated by spaces.
- Comma: data units are separated by commas.
- Tab: data units are separated by tabs.

Enable Checksum Output

Turns on or off a CRC checksum value at the end of each line of data. The software uses this to determine if there was an error when the data was transmitted and that data should be ignored.

Parameter	Description
FrameSync	Enter the ASCII framesync-. Command must end with a "-".
FrameSyncHeader	Shows the model and serial number of the sensor such as ECOv2 00102.
USDateFormat	mm/dd/yy
EURODateFormat	dd/mm/yy
ISO-DateTimeMS	yyyy-mm-ddThh:mm:ss.ttt, where ttt is milliseconds
Time	hh:mm:ss
TimeMS	hh:mm:ss.ttt
Counter	A sample that increments by 1 for each sample taken during a single burst. Counter reaches the burst size as the burst is completed.
Countdown	A counter that starts at the burst size and decrements by 1 for each sample taken during a single burst. Countdown reaches 1 as the burst is completed.
SampleNumber	A counter that starts at zero for the first sample and increments by 1 for each sample recorded. The counter increments with each collected sample and is only reset with the memory is reset.
vMain	The voltage of the input power supply or the input battery.
QASummary	A single digit that shows the worst-case Quality Assurance-Quality Control of Real-Time Oceanographic Data.
NumericQA	A decimal display of the QARTOD status, with 1 digit for each parameter, a human-readable form of the entire QARTOD status.
HexQA	A hexadecimal display of the QARTOD status. Each HexASCII equals 2 QARTOD parameters. A machine-readable form of the entire QARTOD status.

Transmit data

Channel parameters (where x = 1–4, dependent on whether a sensor has 1, 2, 3, or 4 channels of output)

MxEX	Excitation wavelength, nm
MxEM	Emission wavelength, nm
MxHiGain	High gain, counts
MxLoGain	Low gain, counts
Mx 5 Volts	Maximum voltage
MxLTC	LED temperature compensation, counts
MxScaledRaw	Raw output, counts
Mx Units	Engineering output, µg/L
MxUnits	Engineering units (µg/L, m ⁻¹ sr ⁻¹ , ppb, NTU)

6.2 Output formats

The example below shows one possible output of user-selectable parameters for a single-channel fDOM sensor. Sensors with two, three, and four output channels have a tab for each additional available output format.

To modify the output:

1. Push **Get ECO V2 Settings** in the *Dashboard* area of the connected sensor.
2. Push **Modify Format** in the *Output Format* tab of the window that shows.
3. Select the parameters to see in the **Modify Output Format** window.
4. Push **OK**, then **Apply**.

Refer to [Verify operation](#) on page 14 for details to select output descriptions and formats.

Sensor descriptions	Output format, fDOM

Single-channel fDOM with memory

TimeStamp FrameSync USDateFormat Time FDOM (ppb) FDOM ScaledRaw (counts) FDOM LTC (counts) FDOM 5 Volts

example output:

2025-01-T20:14:21.20.342.ECOV2-00012 01/30/25 14:21:20 4.069 795 365 54335

Single-channel fDOM without memory

FrameSync Sample# FDOM (ppb) FDOM ScaledRaw (counts) FDOM LTC (counts) FDOM 5 Volts (counts)

example output:

ECOV2-00012 2177 34.069 795 365 54335

6.3 Transmit data

1. Push **Transmit Data** in the Dashboard area.
The **Transmit Data** window shows.
 - Information in the Memory Summary lets the user see the available data storage in the sensor.
 - "Bytes" is the amount of memory in use.
 - "Samples" is the number of samples the sensor has collected and stored.
 - "Free Samples" is the number of samples the sensor can store.
 - "Sample Length" is sensor-specific and shows the length of each data record that the sensor stores.
2. In the "Transmit Type" drop-down menu in the Data Transmit Options area, select either "All Data" or "Block size (bytes)."
3. In the Data Transmit area, the software automatically selects the fastest baud rate to use to transmit data, which is typically 115200.
The software temporarily increases the sensor's baud rate to upload data more quickly. After the transmission is complete, the software changes the baud rate to what it was before data was transmitted.
4. In the Output CSV Data File area, type a new file name or use the automatically generated file name.
5. Optional: change the time stamp to UTC.
6. Push **Transmit**.
 - The data is transmitted to the PC.
 - The software saves a raw **.sbsdat** file and automatically converts the data to a readable **.csv** file type.
 - The **Transmit Progress** window shows the status of the file transmission and conversion.
 - The default is a check in the boxes for "Show Data when Conversion Completed" and "Close this Dialog when Conversion Completed."

6.4 QA data analysis

Use the data analysis filters to select the measurands and filters for data analysis. Start the filters from either the sensor Dashboard or the **Data** menu. Refer to [Data QAQC](#) on page 31 for details on sensor QAQC.

1. Enter the "File Name" or **Browse** to the .sbsdat file type to process. Push **Open**, then **Next** in Step 1.
2. Put a check in the box next to any or all of the Pass, Suspect, or Fail criteria on which to filter. Push **Next**.
3. Put a check in the box next to any or all of the parameters to filter. Push **Next**.
4. Enter any dark counts or scale factor values for a specific measurand. Push **Next**.
5. Enter the Median and Average Filter Size. Push **Next**.

The sensor uses these values in its real-time calculation of raw and engineering units.

6. To change the directory in which the analysis will be saved, push **Browse**. Push **Finish** for the software to start the analysis
The *QA Analysis Graph* shows next to the *Time Series* tab in the software.
7. Push **Select Measurands and Filters** for more options to filter data. Push **OK**.
The changes show in the graph.
8. To see a data file that has an analysis, go to **Data**, then *ECO V2*, and select *Plot QA Env Processed Data*. Select the .csv file to plot, then select Open.
The data shows in the *QA Analysis Graph*. Push **Select Measurands and Filters** to change the measurands that show.

6.4.1 QA data analysis output format

The output format from the data analysis operation is a comma-separated (.csv) file with various measurands. The file name includes "analysis" instead of "Data." The example below is from a sensor that measures backscattering and chlorophyll. Header information is approximately 170 rows with information about the measurands selected for the analysis.

The file starts with—

```
<!-- ECO V2 -->
```

```
<SBS_QA_File>
```

and ends with—

```
</QAProcessingSettings>
```

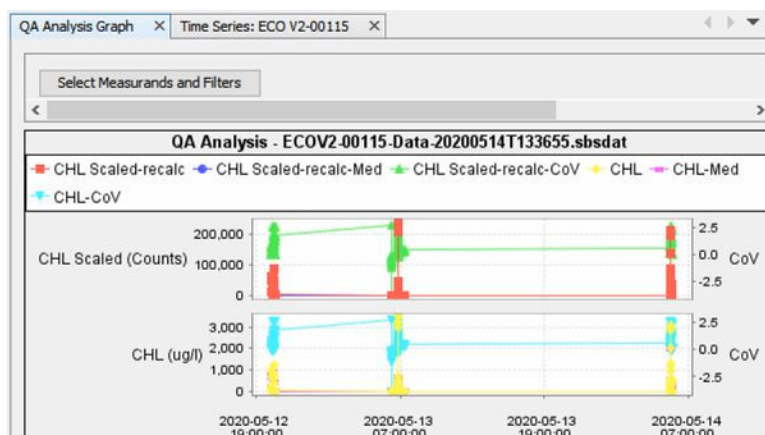
```
</SBS_QA_File>
```

174	</SBS_QA_File>											
175	Date (MM/dd/yyyy)	Time (HH:mm:ss)	Date Med	Date Aver	Date Std	Date Coef	Date Spike	Time Med	Time Aver	Time Std	Time Coef	Time Spike
176	5/12/2020	15:34.0										
177	5/12/2020	15:35.0										
178	5/12/2020	15:49.0										
179	5/12/2020	15:50.0	1.59E+12				0	1.59E+12				0
180	5/12/2020	15:51.0	1.59E+12				0	1.59E+12				0
181	5/12/2020	15:52.0	1.59E+12				0	1.59E+12				0
182	5/12/2020	15:53.0	1.59E+12	1.59E+12	0	0	0	1.59E+12	1.59E+12	50520.15	0	0
183	5/12/2020	15:54.0	1.59E+12	1.59E+12	0	0	0	1.59E+12	1.59E+12	55333.62	0	0
184	5/12/2020	17:35.0	1.59E+12	1.59E+12	0	0	0	1.59E+12	1.59E+12	55333.62	0	0

12599	12549							181.835								7824
12581	12531							181.5742								7805
12461	12411							179.8354								7666
12458	12408	12408					0	179.7919	179.7919					0		7660
12458	12408	12408					0	179.7919	179.7919					0		7657
12451	12401	12401					0	179.6905	179.6905					0		7641
12423	12373	12397	12386.29	22.35855	0.001805	-24	179.2848	179.6325	179.4773	0.323975	0.001805	-0.34776				7620
12447	12397	12373	12379	22.41279	0.001811	24	179.6325	179.2848	179.3717	0.324761	0.001811	0.34776				7637
12410	12360	12360	12371.71	19.51678	0.001578	0	179.0964	179.0964	179.2661	0.282798	0.001578			0		7618

7774								0.028896								
7755								0.028825								
7616								0.028309								
7610	7610						0	0.028286	0.028286					0		
7607	7607						0	0.028275	0.028275					0		
7591	7591						0	0.028216	0.028216					0		
7570	7587	7585.571	18.35626	0.00242	-17	0.028138	0.028201	0.028196	0.000068	0.00242	-6.3E-05					
7587	7570	7579.286	15.97617	0.002108	17	0.028201	0.028138	0.028172	0.000059	0.002108	0.000063					
7568	7568	7573.286	10.91962	0.001442	0	0.02813	0.02813	0.02815	0.000041	0.001442				0		

The graph shows in the software next to the *Time Series* tab.



6.5 Erase data stored in sensor

Sensors will append data as it is collected. If the memory is full, new data is saved over the oldest data and will continue to do that until the memory is erased. This operation erases all data stored in the sensor. It is not possible to select which data to erase.

1. Select the **Sensor** menu item.
2. Select the connected sensor.
3. Select *Advanced*.
4. Select *Erase Data*.
5. Push **OK**.
6. Push **OK** when the status in *Clear Data Progress* is 100%.

⚠ WARNING



If the user thinks that a sensor has water in the pressure housing: Disconnect the sensor from any power supply. Put on safety glasses and make sure that the sensor is pointed away from the body and other people. In a well ventilated area, use the purge port (if the sensor is so equipped), or very SLOWLY loosen the bulkhead connector to let the pressure release.

The manufacturer recommends that the user returns the sensor for calibration at regular intervals. The measurement accuracy of the sensor may decrease if the sensor is stored unused for long periods of time.

The ECO V2 series of sensors has optional components that are the only user-serviceable items:

1. One-or three-armed copper Biowiper and rubber blades—Refer to [Remove and replace wiper and clean faceplate](#) on page 25 for details.
2. Copper faceplate—refer to [Remove and replace wiper and clean faceplate](#) on page 25 for details.
3. Battery pack—refer to [Install batteries](#) on page 11 for details.
4. Pressure relief plug—refer to [Maintain pressure relief plug](#) on page 25 for details.

7.1 Remove or replace batteries

Refer to [Install batteries](#) on page 11 for details on these steps.

7.2 Maintain pressure relief plug

The manufacturer recommends that the user verify the functionality of the optional pressure relief plug and the installed O-rings when the batteries are replaced to limit the number of times the end flange is removed from the pressure housing.

1. Pull the pressure relief plug loose from the top of the end flange.
2. Dry the pressure relief plug.
3. Remove the end flange.
Refer to
4. Remove the screw on the inside of the end flange that holds the pressure plug.
5. Examine the size 110 O-rings on the pressure plug.
6. If it is necessary to replace the O-rings, apply a light coat of vacuum grease on any new O-rings and then install them on the pressure plug.
7. Install the pressure plug into the end flange again.
8. Carefully tighten the screw on the inside of the end flange that holds the pressure plug.
9. Make sure that the pressure relief plug is pushed all the way down on the end flange.

7.3 Remove and replace wiper and clean faceplate

Sensors that have copper face-plates and copper Bio-wipers need to be cleaned at regular intervals to keep the copper effective as an anti-fouling aid. Remove the Bio-wiper and faceplate from the sensor to clean them. See also the "how to" video on the manufacturer's website to do this procedure.

Note:

NOTICE

Do not remove the copper ring. This will void the warranty.

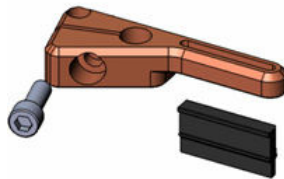
NOTICE

Do not twist the Bio-wiper or the Bio-wiper shaft by hand. It will cause damage to the motor. Push **Check Wiper** on the sensor Dashboard in the software to make sure that the Bio-wiper operates correctly.

1. Disconnect the sensor from any power source.
2. Remove the wiper from the faceplate:
 - For sensors with a single optical cutout, use the manufacturer-supplied 3/32" hex key to loosen the screw that holds the Bio-wiper to the sensor.
 - For sensors with three optical cutouts, use the manufacturer-supplied 1/16" hex key to loosen the screw that holds the Bio-wiper to the sensor.



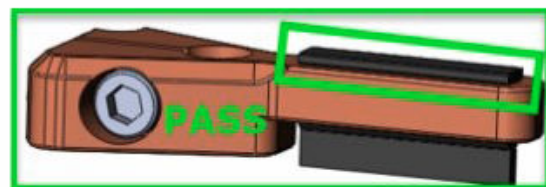
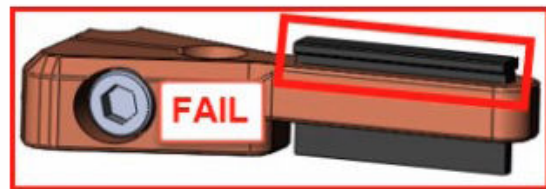
3. Lift the Bio-wiper off of the shaft.
4. Pull down on the long exposed part of the wiper to remove the rubber wiper from the copper wiper arm.



5. Wet each wiper blade with isopropyl alcohol and push them into the bottom of the copper wiper arm slot as shown.
It may be necessary to move the rubber back and forth to get it completely through the slot. Put the wiper blade in the slot so that the top flat end of the wiper blade is against the wiper arm as shown.



Single-blade Bio-wiper in correct position



Blade position pass/fail

6. Use a small Phillips screwdriver to remove the screws that attach the faceplate to the optics face.



7. Keep the screws.
8. Clean the Bio-wiper and faceplate with soapy water.
9. Rinse and dry thoroughly.
10. Use a Scotch-Brite® or similar pad to carefully buff the Bio-wiper, faceplate, and copper ring until they are shiny.
11. Use an isopropyl alcohol-saturated cotton swab to clean the Bio-wiper shaft and the shaft hole.
12. Make sure the Bio-wiper, faceplate, and copper ring are completely dry.
13. Attach the faceplate again.
14. Put the wiper arm onto the wiper arm shaft but do not tighten.
15. Put the wiper arm close to the optical face.
16. Make sure that the wiper is the correct height:
 - Make sure that the rubber of all blades lightly touches the copper faceplate evenly.
 - Verify that a gap cannot be seen under every blade when all of the blades lightly touch the copper faceplate. Adjust the blades in the wiper arm if necessary.
 - The rubber will bend approximately 30 degrees against the optical face, which is higher than the copper faceplate.



17. Use the appropriate hex key to tighten the wiper arm on the shaft. Do not over-tighten.

7.4 Examine O-rings

NOTICE

Do not use petroleum-based lubricants on O-rings. It will cause damage to the O-rings. Damaged O-rings can cause the sensor to flood and make it unserviceable.

Examine the O-rings on the sensor every time they are exposed—on the connector end flange and other parts. O-rings must be pristine. If there is any question about whether an O-ring is clean and undamaged, replace it with a new one.

1. Dry the O-rings and O-ring grooves with a lint-free cloth or tissue.
2. Examine each O-ring to make sure there is no damage, dirt, lint or hair on it.

- 3. Replace an O-ring if necessary.
- 4. Apply a small quantity of silicone-based Parker Super O Lube® or Dow Corning® high vacuum grease to each O-ring.
 - The lubricant helps the O-ring move into its groove with no twist, which can compromise the seal.
 - Do NOT use petroleum-based lubricants on any O-ring.






7.5 Clean bulkhead connectors

NOTICE

Do not use WD-40® or petroleum-based lubricant on bulkhead connectors. It will cause damage to the rubber.
Damaged connectors can cause a loss of data and additional costs for service.
Damaged connectors can cause damage to the sensor and make it unserviceable.
Use silicone-based lubricants only.

Examine, clean, and lubricate bulkhead connectors at regular intervals. Connectors that are not lubricated increase the damage to the rubber that seals the connector contacts. The incorrect lubricant will cause the failure of the bulkhead connector.

- 1. Apply isopropyl alcohol (IPA) as a spray or with a nylon brush or lint-free swab or wipes to clean the contacts.
- 2. Flush with additional IPA.
- 3. Shake the socket ends and wipe the pins of the connectors to remove the IPA.
- 4. Blow air into the sockets and on the pins to make sure they are dry.
- 5. Use a flashlight and a magnifying glass to look for:

Any corrosion.		
Cracks, scratches, or other damage on the rubber pins or in the sockets.		
Separation of the rubber from the pins.		
Swelled or bulging rubber pins.		

- 6. Use a silicone-based lubricant on each of the contacts of the bulkhead connector. The manufacturer recommends any of the products listed below.
 - 3M™ Spray Silicone Lubricant (3M ID# 62-4678-4930-3). Make sure to let it dry.
 - Dow Corning Molykote® III Compound (DC III)
 - Dow Corning High Vacuum Grease® (DC 976 V)

- Dow Corning 4 Electrical Insulating Compound® (DC 4)
- Dow Corning Molykote 44 High Temperature Grease® (DC 44)

Use a finger to put a small quantity of 100% silicone grease or spray in the sockets or on the pins. Use the mating plug or cable to help distribute the lubricant. Do not use too much lubricant, as that will prevent a good seal.

7. Connect the connectors.
8. Use a lint-free wipe to clean any unwanted lubricant from the sides of the connectors.

7.6 Spare parts and accessories

Table 2 Anti-fouling parts, sensors with wipers

Part number	Description	Qty
BAA-JX0004	spare parts kit, which includes:	
	MAA-520001, orange fluorescent stick	1
	MAA-520002, green fluorescent stick	1
	MAA-520003, blue fluorescent stick	1
	GXA-SX0050, 3/32" short hex wrench	1
	GXA-SX0059, 1/16" short hex wrench	1
	MAA-907939, pop-in wiper blade	3

Table 3 Battery kit

Part number	Description	Qty
BAA-JX0006	Battery spare parts kit, which includes:	
	50441, 12 size AA lithium batteries	1
	31755, 8-32 x 1/4" titanium socket head cap screw	2
	GXA-HX0025, size 033 Buna-N O-ring	2
	GXA-HX0152, size 145 Buna-N O-ring	2
	XXX-GX0001, DC 111 grease, 6 grams	1
	GXA-SX0102, 9/64" short hex wrench	1

Table 4 Accessories

Part number	Description
FAS-519708	14½" flow-through housing
FAS-519709	3- and 4-measurement (Triplet-w, Quad-w) flow-through housing

7.7 Calibration

The manufacturer calibrates all scattering sensors to make sure that the data that is collected meets the specifications for the sensor. The calibration information is stored in the sensor. The user can use the software to see the calibration values.

7.8 Characterization

The manufacturer uses a fluorescent material to characterize all fluorescence sensors to make sure that the data that is collected meets the specifications for the sensor. The

characterization information is stored in the sensor. The user can use the software to see the characterization values.

7.8.1 Field characterization

The manufacturer recommends that the user perform a field characterization on fluorimeters to make sure that the data is as accurate as possible for the user's application. The scale factor and the dark counts values can vary depending on the natural water, temperature, length of the cable, the power supply, and other factors.

Do the steps below to field-characterize the sensor.

- **x** = a solution of a known concentration in volts or counts.
 - **output** = the measured sample of interest in volts or counts.
 - **dark counts** = the measured signal output in volts or counts of the sensor in clean water with black tape over the detector.
 - **scale factor** = the multiplier in $\mu\text{g/L/volt}$, ppb/L/volt , OR $\mu\text{g/L/count}$, ppb/L/count .
1. Get a solution of a known concentration, **x**.
 2. Measure and record this solution using the sensor.
This value is the **output** in volts or in counts.
 3. Measure and record the sensor's **dark counts**.
 4. Use this equation to determine the sensor's **scale factor**:
$$\text{Scale factor} = x \div (\text{output} - \text{dark counts}).$$
 5. Use the scale factor to determine the concentration of the sample of interest:
$$(\text{output counts} - \text{dark counts}) \times \text{scale factor} = \text{concentration of solution}.$$
 6. Store the scale factor and dark counts (offset) in the internal memory of the sensor.

Section 8 Data QAQC

Current efforts are to follow the Quality Assurance-Quality Control of Real-Time Oceanographic Data (QARTOD) as written by the US Integrated Ocean Observing System (IOOS).

QC flag values		
Flag	Value	Description
Pass (green)	1	Data have passed the QC test and are deemed adequate for use.
Suspect (yellow)	2	Data are considered to be either suspect or of high interest.
Fail (red)	3	Data are considered to have failed QC tests or are missing.

QC tests

- Input voltage
- Wiper position (if so-equipped)
- Gross range
- Timing
- Date and time
- Median filter

Input voltage: does the sensor operate within the specified range of 7–15 V?

Flag	Value	Description
Pass	1	Input voltage is between 7 and 15
Fail	3	Input voltage is below 7 or above 15

Wiper position: is the wiper in the correct position for operation?

Flag	Value	Description
Pass	1	Wiper is in the correct position
Fail	3	Wiper is not in the correct position

Gross range: is the output a numeric value within the specified range of 0–65,536 counts?

Flag	Value	Description
Pass	1	Any value between 0 and 65,536
Fail	3	Any value higher than 65,536 or any negative value

Timing: does the frequency of the user-selected data output agree with the frequency of data output from the sensor?

Flag	Value	Description
Pass	1	The user-selected output frequency agrees with the sensor output frequency
Fail	3	The user-selected output frequency does not agree with the sensor output frequency

Date and time: does the date and time show in a valid format?

Flag	Value	Description
Pass	1	The date and time show in a valid format
Fail	3	The date and time show in something other than a valid date format

Median filter: removes spikes from the raw data set. The filter window can be adjusted to the variance in the data set to the expected variance time scale, e.g. tidal. The median filter replaces the QARTOD spike test with the advantage that the threshold does not have to be set by the operator for each measurand.

Section 9 ECO V2 terminal command set

The user can send terminal commands from a terminal program or the UCI software. The table below lists commands and functions, where Y = 1, N = 0.

Commands are not case-sensitive: GetCD is the same as getcd.

Always active	
ECO V2 command	Description
GetCD	show configuration data
GetEC	show event counters
GetHD	show hardware information
GetSD	show status data
GetCC	show calibration coefficients
GetQA	show QA flags
GetDarkCounts	show calibration dark count minimum, maximum, average
GetPower	show the XML response with power levels for each stage of a sample interval. This information also shows in the response to GetHD.
GetRanges	show maximum measurement range for each channel
GetFS	show factory settings
GetOutStr	shows current OutStr in verbose mode
OutStr=O	show current output index
GetOT	show current output table
OTRevision	show output table revision number
Help	show a list of commands
TS	take a single sample
TSS	take and store a single sample
SL	send last sample in OutStr format

Only active in standby mode	
ResetEC	reset all event counters
QS	put sensor in low power mode ("quiescent")
ShowDefaultOutStr	show default output
ShowDefaultOutput	
ReloadDefaultOutput	load the default output to the current OutStr, delimiter, and OutputFormat
ShowDefaultCal	show the manufacturer-set calibrations; do not load them over the current settings
DateTime	set date and time (mmddyyyyhhmmss)
BaudRate=x	set baud rate to x. Send command twice, the second time at the new baud rate.
TBaudRate	temporarily set the baud rate to tBR. The baud rate reverts to the previous baud rate when power is turned off, then on. Requires confirmation.
OutputCRC=x	controls the CRC output in OutStr. If x=1, the CRC output is transmitted. If x=0, the CRC output is not transmitted.
OutputExecutedTag	controls the output of an <Executed/> tag X=1: the tag shows. X=0: the ECOV2 prompt shows
EraseMemory	erase all stored sample data

ECO V2 terminal command set

EraseMemory=x	erase all stored sample data pages from 0 to x
EraseMemory=all	erase all stored sample data pages
TXRealTime=x	x=y: transmit real-time data. x=n: do not
Delimiter=d	set OutStr delimiter to d, where d=C for comma, d=T for tab, d=S for space.
Outsr	Shows ASCII command format of user-selectable settings so the current configuration can be loaded again at a later date/time.
GetUserSettings	shows a subset of GetUserSettings and does not require that Factory Mode is enabled
AnalogOut=A,M,C,R	set analog A (1–2) to transmit M (1–4) with calibration C (1–2) with a full range display of R, where a maximum value of R shows with the GetRange command
AnalogOut=A,0,0,0	turn off analog A
AnalogOut=A,0,0,n.nn	set analog A to a constant n.nn volts of output, where n.nn is 0.00 to 4.950
AutoRun=x	x=1 or Y: starts when power is supplied. x=0 or N: does not
BurstSize=x	x=number of samples to take each sample period. If x=0, the sensor operates continuously. Range: 0-86400.
BurstInterval=x	set sample interval in seconds between the start of the Bursts. Range is 10–86400.
NumberOfBursts=x	set the number of data burst to be collected to x. If x=0 the sensor operates bursts or intervals continuously
DataRateHz	set the data rate to Hz. If DataRateHz is sent without a parameter the current data rate shows.
StartNow	start data collection. The sensor uses the parameters shown in GetCD.
StartDateTime=x	x=mmddyyyyhhmmss. Set the date and time to start the burst sequence. Used before the StartLater command.
StartLater	schedule the ECO to start data collection at the time set in StartDateTime
GetSamples	transmit all samples between sample number X and sample number Y with the OutStr format. Sample number starts at 0.
GetSamples=x, y	
mvs	operates the wiper one time
Get1Hz	get and show the 1 Hz clock count value
g1hz	
TSN	take x samples (samples are not stored)

Active only during data collection	
Stop	stop data collection (software only)
!!!!	stop data collection
esc esc esc (push three times)	

9.1 Details on output string (OutStr) index and output table (GetOT)

The output string (OutStr) contains values from the output table (GetOT) to configure the ECO V2 output.

The two sections below use an ECO V2 triplet with memory and a real-time clock configured to measure chlorophyll at 470 nm, backscattering at 700 nm, and fDOM at 370 nm as an example.

9.1.1 ECO V2 output string index

The manufacturer-supplied OutStr is:

OutStr=0,3,7,30,31,33,55,56,60,59,80,81,83,195

The response to GetOutStr is:

```
<OutStr string='FrameSync,USDateFormat,Time,M1_LTC,M1_RawScale,
M1_CAL1Units,M2_LTC,M2_RawScale,M2_CAL1AltUnits,M2_CAL2Units,M3_LTC,M3_
RawScale,M3_CAL1Units,vMain'/>
```

Index	Description	Units	Range
0	FrameSync: xxxxx is 5-digit serial number		ECOV2-xxxxx
3	US date format	mm/dd/yy	
7	Time	hh:mm:ss	00:00:00–23:59:59
M1: ChI-470			
30	LED temperature compensation	counts	0-65535
31	RawScale (digital) output	counts	0-655,350
33	engineering values, Cal1	$\mu\text{g L}^{-1}$	0–400
M2: Backscattering-700			
55	LED temperature compensation	counts	0-65535
56	RawScale (digital) output	counts	0-655,350
60	engineering values, EngAlt x.xxxE-yy output, Cal1	$\text{m}^{-1} \text{sr}^{-1}$	0–9.500E-01
59	engineering values, Cal2	NTU	0-350
M3: fDOM-370			
80	LED temperature compensation	counts	0-65535
81	RawScale (digital) output	counts	0-655,350
83	engineering values, Cal1	ppb	0–900
195	main voltage	volts	0–16 VDC

ASCII ECO V2 output:

```
FrameSync|  Date      Time M1LTC  SR1   Engr1  M2LTC SR2  EngAlt2 Engr2  M3LTC  SR3 Engr3  vMain
ECOV2-00278 02/17/25 23:24:26 30636 2100.909 23143 2360 3.150E-03 7.011 46905 359138.435 11.80
ECOV2-00278 02/17/25 23:24:27 30635 2110.915 23143 2358 3.147E-03 7.010 46905 359138.435 11.80
```

Notes:

- RawScale output transparently combines digital output from a measurand's high-gain and low-gain detector stages such that the calibration coefficients for the hi-gain stage can be used to recalculate the engineering values in off-line post-processing.
- To change the output from tab-delimited to comma-delimited, simply add index 224 to the OutStr command:

OutStr=0,3,7,30,31,33,55,56,60,59,81,83,195,**224**

The output changes to:

```
ECOV2-00278,02/17/25,23:24:27,30635,211,0.915,23143,2358,3.147E-03,46905,3591,38.435,11.80
```

9.1.2 Output table (GetOT)

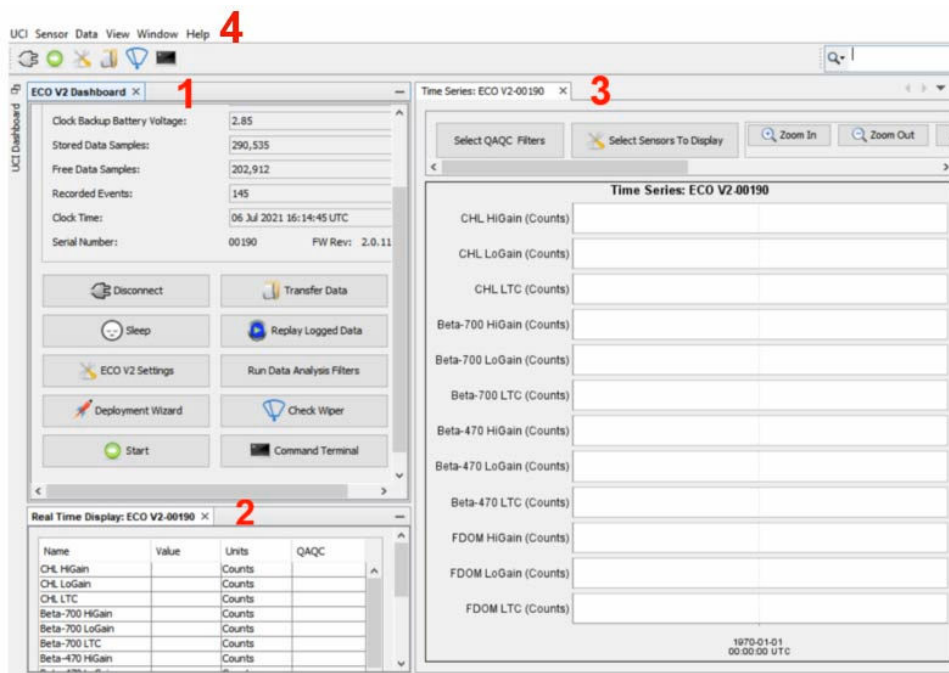
The indices used by OutStr in the example output string above are shown in **bold** below.

```
< OutputTable DeviceType='ECOV2' SerialNumber='00278' Revision='3'>
  <Idx Type='Frame' Key='FrameSync'>0</Idx>
  <Idx Type='ASN' Key='FrameSyncHeader'>1</Idx>
  <Idx Type='NSN' Key='Numeric-SN'>2</Idx>
  <Idx Type='Date' Key='USDateFormat' Format='MM/DD/YY'>3</Idx>
  <Idx Type='Date' Key='EURODateFormat' Format='DD/MM/YY'>4</Idx>
  <Idx Type='DandT' Key='ISO-DateTimeMS' Format='YYYY-MM-DDTHH:MM:SS.TTT'>6</Idx>
  <Idx Type='Time' Key='Time' Format='hh:mm:ss'>7</Idx>
  <Idx Type='Time' Key='TimeMS' Format='hh:mm:ss.ttt'>8</Idx>
  <Idx Type='AI' Key='Counter' Plot='No'>9</Idx>
  <Idx Type='AI' Key='Countdown' Plot='No'>10</Idx>
  <Idx Type='AI' Key='SampleNumber' Plot='Yes'>11</Idx>
  <Measurement id='CHL-470'>
    <Idx Type='AI' Key='CHL-470 EX Wavelength' Units='nm' Plot='No'>25</Idx>
    <Idx Type='AI' Key='CHL-470 EM Wavelength' Units='nm' Plot='No'>26</Idx>
    <Idx Type='AI' Key='CHL-470 HiGain' Units='Counts' Plot='Yes'>27</Idx>
    <Idx Type='AI' Key='CHL-470 LoGain' Units='Counts' Plot='Yes'>28</Idx>
    <Idx Type='AI' Key='CHL-470 5 Volts' Units='Counts' Plot='Yes'>29</Idx>
    <Idx Type='AI' Key='CHL-470 LTC' Units='Counts' Plot='Yes'>30</Idx>
    <Idx Type='AI' Key='CHL-470 ScaledRaw' Units='Counts' Plot='Yes'>31</Idx>
    <Idx Type='AF' Key='CHL-470' Units='ug/l' Plot='Yes'>33</Idx>
    <Idx Type='AF' Key='CHL-470 EngAlt' Units='ug/l' Plot='Yes'>35</Idx>
  </Measurement>
  <Measurement id='BackScattering-700'>
    <Idx Type='AI' Key='Beta-700 EX Wavelength' Units='nm' Plot='No'>50</Idx>
    <Idx Type='AI' Key='Beta-700 EM Wavelength' Units='nm' Plot='No'>51</Idx>
    <Idx Type='AI' Key='Beta-700 HiGain' Units='Counts' Plot='Yes'>52</Idx>
    <Idx Type='AI' Key='Beta-700 LoGain' Units='Counts' Plot='Yes'>53</Idx>
    <Idx Type='AI' Key='Beta-700 5 Volts' Units='Counts' Plot='Yes'>54</Idx>
    <Idx Type='AI' Key='Beta-700 LTC' Units='Counts' Plot='Yes'>55</Idx>
    <Idx Type='AI' Key='Beta-700 ScaledRaw' Units='Counts' Plot='Yes'>56</Idx>
    <Idx Type='AF' Key='Beta-700' Units='m-1 sr-1' Plot='Yes'>58</Idx>
    <Idx Type='AF' Key='Beta-700 EngAlt' Units='m-1 sr-1' Plot='Yes'>60</Idx>
    <Idx Type='AF' Key='NTU-700' Units='NTU' Plot='Yes'>59</Idx>
  </Measurement>
  <Measurement id='fDOM'>
    <Idx Type='AI' Key='fDOM EX Wavelength' Units='nm' Plot='No'>75</Idx>
    <Idx Type='AI' Key='fDOM EM Wavelength' Units='nm' Plot='No'>76</Idx>
    <Idx Type='AI' Key='fDOM HiGain' Units='Counts' Plot='Yes'>77</Idx>
    <Idx Type='AI' Key='fDOM LoGain' Units='Counts' Plot='Yes'>78</Idx>
    <Idx Type='AI' Key='fDOM 5 Volts' Units='Counts' Plot='Yes'>79</Idx>
    <Idx Type='AI' Key='fDOM LTC' Units='Counts' Plot='Yes'>80</Idx>
    <Idx Type='AI' Key='fDOM ScaledRaw' Units='Counts' Plot='Yes'>81</Idx>
```

```
<Idx Type='AF' Key='FDOM' Units='ppb' Plot='Yes'>83</Idx>
<Idx Type='AF' Key='FDOM EngAlt' Units='ppb' Plot='Yes'>85</Idx>
</Measurement>
<Idx Type='AF' Key='vMain' Units='Volts' Plot='Yes'>195</Idx>
<Idx Type='AI' Key='QASummary' Plot='No'>200</Idx>
<Idx Type='AS' Key='NumericQA' Plot='No'>201</Idx>
<Idx Type='AS' Key='HexQA' Plot='No'>202</Idx>
<Idx Type='Format' Key='Variable'>215</Idx>
<Idx Type='Format' Key='Fixed'>216</Idx>
<Idx Type='Delimit' Key='Space' Chars='\x20'>223</Idx>
<Idx Type='Delimit' Key='Comma' Chars='\x2c'>224</Idx>
<Idx Type='Delimit' Key='Tab' Chars='\x09'>225</Idx>
</OutputTable>
```


Section 10 Software reference

When the sensor operates with the UCI software, the three tabbed windows typically show. The user can change the size of the windows and move them around outside the main UCI window. The software is very flexible about how and where windows are located. Windows can "float" or be "docked" as necessary.



1	Dashboard	Sensor-specific, with status data and operational controls
2	Views: <ul style="list-style-type: none">Real-time DataData CollectionAcquisition MonitorMessage File	Information about data collection
3	Time Series	View of real-time data, a plot of saved data, or a plot of QA analysis
4	Menus	UCI, Sensor, Data, View, Window, Help

10.1 Sensor dashboards

The Dashboard is the main area from which to control and communicate with the sensor. Information about the status of the sensor is contained in the upper part of the window and is updated each time the sensor is connected to the software. To see the dashboard, select it from the **View | Dashboards** menu item.

Common settings

- **Connect-Disconnect** lets the user disconnect the sensor after it is set up for operation.
- **Start-Stop** lets the user start and stop data collection.
- **Sensor Settings** lets the user select options for a specific deployment.
- **Deployment Wizard** lets the user select a deployment mode, start time, the parameters to measure, estimate the deployment time and data collection interval, and make a summary report of the status of the sensor.
- **Transmit Data** lets the user move data saved on the sensor to a PC.
- **Show Saved Data** lets the user see data that was saved on a PC in a graph.

- **Command Terminal** lets the user send terminal program-level commands to the sensor.

10.1.1 ECO V2 settings

ECO V2-specific settings:

- **Sleep** puts the sensor in a low power mode.
- **Replay Logged Data** lets the user select a .sbsdat file type and to show in the *Time Series* window of the sensor.
- **Run Data Analysis Filters** is a six-step wizard that lets the user do a QAQC analysis of data.
- **Check Wiper** lets the user operate the anti-fouling wiper for one cycle.

Many of the sensor settings can be changed with the **ECO V2 Settings** button in the Dashboard. The options are almost the same as those in the **Deployment Wizard**.

- *Output format*—push **Modify Format** to see a list of available data parameters. Select or deselect parameters here or in step 2 of the Deployment Wizard. Refer to [Output description](#) on page 19 for details about the available parameters.
- *Samples*—Select the sample settings and interval.
The "Data Rate" is 1, 2, or 4 Hz.

Put a check in the box at "Start Sampling at Power Up" to set the sensor to come on when the power is turned off and then on again. The mode of operation will be the saved settings from the *Samples* tab.

Burst Settings: Put a check at "Sample Continuously" or remove the check to set a user-specified interval:

- Continuously: the sensor operates at the selected Hz rate. (Default = 1).
- Interval:
 - Burst start interval—Select a time to start data collection. Set to one day or up to 23:59:59.
 - Number of samples per burst—Select the number of samples to collect during x bursts. Range is 1–86400 and is dependent on the start interval.
 - Number of bursts—Select the number of times, or bursts, that the sensor collects data.

Push **Apply** to save the settings in the sensor.

Push **Default** to see the manufacturer-set values for data collection:

- Burst start interval: 00:15:00.
- Number of samples per burst: 4.
- Number of bursts: 10.
- *Transmit Data*—Add or remove the check to transmit data in real time to a controller when the sensor operates in autonomous mode.
- *Baud Rate*—The software automatically determines the baud rate at which the sensor transmits data. (Default=19200).
- *Analog Output*—Select which of the available data measurements are to be output on either of the two analog outputs. If analog outputs are not needed, select the **None** option. The "Max Range" field can be used to specify the engineering units value for a measurement that corresponds to the typical maximum analog output voltage of 4.95 volts.

10.2 View options

The options in the **View** menu let the user see information about the status of data collection.

Dashboards— Go to the **View** menu and *Dashboards* to select the dashboard for a specific sensor.

Graphs— Go to the **View** menu and select *Time Series* to see data in real-time. Refer to [Time series](#) on page 41 for details about the options to see data.

Output— Go to the **View** menu and select *Output*, then any of the three options:

- *Instrument Console*: see the current settings in the sensor, and data in real time.
- *Processing Console*: the data collected by the sensor in a comma-delimited format
- *Application Console*: the commands sent to the sensor from the software.

Real Time Data— Go to the **View** menu and select *Real Time Data* to select the parameters that the specific sensor will use for data collection.

Data Collection —Go to the **View** menu and select *Data Collection* to select the location on the PC in which the collected data is saved.

Acquisition Monitor —Used by the manufacturer for troubleshooting.

Message File —Used by the manufacturer for troubleshooting.

10.3 Time series

The Time Series graph lets the user see data in real time. There are a number of options available to adjust how data shows.



- **Select QAQC Filters**—Select "Pass," "Suspect," or "Fail" to identify any data that meets the selected filter criteria. Default: all are selected.
- **Select Sensors To Display**—Select the parameters to show in the Time Series window. The sensor collects data for all parameters. This selection just lets the user choose what to see. The maximum number of parameters for a plot is 12.
- **Controls**—
 - Use **Zoom In** and **Zoom Out** to change the level of detail that shows. More detail is available if "Time Axis" or "Range Axis" is selected. Push **Auto Range** or **Default Ranges** to go to the default display settings.
 - **Dark Scheme** changes the background to a dark color.
 - "Show Data Points"—A check in this box (default) shows data points. If there is no check, the data shows as lines only.

Other options

- Use the scroll wheel on a mouse to zoom in or out on data.
- Click anywhere in the Time Series graph to add a vertical line near data to zoom in on, then drag the mouse to see more detail.

The Time Series graph is enabled by default. To disable this graph:

1. Select the **UCI** menu, then *Preferences*.
2. Select **Display**.
3. Remove the check in the box at "Enable Time Series Graph."
4. Push **Apply**, then **OK**.

10.4 UCI software menus

10.4.1 UCI menu

The user can set up the way that the software saves information about the operation of the sensor and change the way that the data looks from the *Preferences* menu.

10.4.1.1 General tab

Enter or change the directory on the PC in which data from the sensor is stored.

- "Maximum Wakeup Attempts" lets the user select the number of times the software will try to connect to a sensor. Range: 5–15.
- "Response Timeout" is the interval of time between communication between the sensor and the software. Range: 5–10.
- "Default Data Directory" lets the user enter the location on the PC in which to save data from the sensor. If there is a check in the "Prompt at startup" box, the user can change the directory in which the data is stored every time the software starts.

10.4.1.2 Display tab

Note: *The software operates faster if the user selects less data and only one or two graphs.*

Data that is collected by the sensor shows in the user-selected graphs in the Performance Optimization Settings area of the *Display* tab.

- "Enable Real Time Display"—Put a check in this box to see the data as it is collected in either the software, or if deployed, a terminal program.
- "Enable Time Series Graph"—Put a check in this box to see user-selected data. Remove the check in the box to so that the graph is disabled and the data does not show.
- SUNA only: "Enable Spectra Graph"—Put a check in this box to see both dark and light data in raw counts. Refer to [Monitor spectra](#) for details.
- SUNA only: "Enable Total Absorbance Graph"—Put a check in this box to see the calculated absorbance. Refer to [Monitor absorbance](#) for details.

Time Series Settings—The default is a check in the box for continuous data collection that is not limited to a specified amount of time. Remove the check in the box to enable the "Time Axis Range Limit" of 60 minutes (default value). Only the most recent hour of data will show in the *Time Series Graph*. The user-selectable range is 1–1440 minutes.

10.4.1.3 Message tab

The software automatically saves files that have information about sensor use, data collection, and software operation over time. This information helps the user and Customer Support find problems and troubleshoot.

When the "Display Dialog for Error Level Messages" box has a check in it, the software saves one of five levels of error messages.

- **INFO**—The default level. All high-level operations are saved.
- **ERROR**—Minimum level. Only errors that need to be examined by the user or Customer Support are saved.
- **WARN**—Low level. The files that are saved do not have enough information for the user to make an analysis of how the sensor is used and set up.
- **DEBUG**—High level. Used to troubleshoot. **DEBUG** and **TRACE** files are very large.

- **TRACE**—The highest level. Used only to troubleshoot.

"Daily Files"—all messages from a single day are saved in one file.

"Rolling Files"—all messages are saved in one file until it is the maximum size specified by the user. The messages are then saved to a new file. The user specifies the number of files to keep. The oldest files are erased first.

"Save Lost Bytes"—if this box has a check in it, the software saves all of the unexpected output from the sensor to a file.

"File Location"—the operating system of the PC determines where these files are saved.

10.4.2 Sensor menu

The **Sensor** menus have options for each sensor with which the software communicates. Refer to the sections on [Sensor dashboards](#) on page 39 for more information about these items.

Advanced Sensor menu items

Common

- *Erase Data* lets the user erase all of the data stored in the sensor.
- *Summary Report* lets the user get a summary of the settings stored in the sensor.
- *Set Clock* lets the user synchronize the time between the PC and the sensor.
- *Collect Diagnostics* is helpful for troubleshooting.
- Optional: *Pair Optics Cal Cap* lets the user enter the serial number of a new check cap to connect, or "pair" it with the sensor.
- Optional: *Upgrade Firmware* lets the user install the latest firmware from the manufacturer.

10.4.2.1 ECO V2

- *Erase Saved Data* lets the user erase all of the data saved in the sensor.
- *Deployment Endurance* lets the user estimate how long the batteries will last for a specific deployment.
- *Upgrade Firmware* lets the user install the latest firmware from the manufacturer.
- *Load Factory Defaults* lets the user install the manufacturer-set configuration settings.
- *Restore Settings from File* lets the user configure the settings previously stored in the PC.
- *Enter Legacy Mode* lets the user put the ECO V2 into legacy mode. Because legacy mode is not currently compatible with UCI, the ECO will be disconnected after being put into legacy mode.

10.4.3 Data menu

The **Data** menu has sensor-specific options to look at data that has been saved to a PC.

10.4.3.1 Export data to .csv or MS Excel format

Data from the sensor can be saved to either a comma-separated (.csv) file or a Microsoft® Excel file with a local or UTC time stamp. Use the software to transmit data from the sensor and then export that data to a human-readable format.

1. From the **Data** menu, select *Export Stored Data*.
2. Push **Browse** to find the file to export.
3. Select the file from the list.
4. Push **Open**.
5. Push **Next**. The current output format shows (all sensors but SUNA).
6. Push **Next**. Select the options for the file to export:
 - a. Select either "Excel Workbook" or "Comma Separated Values" in Export File Format.

- b. Select the "Local" time stamp in Format Options.
7. Push **Browse** to select the directory in which the exported data will be saved.
8. Push **Finish**.

10.4.3.2 Show data from multiple sensors

The software lets the user show data that has been saved on the PC from each supported sensor. The user can select up to 12 parameters to look at.

1. Go to the **Data** menu, then *Show Data from Sensor*.
2. Go to the area of the first supported sensor and push **Browse** to go to the .csv file-type.
3. Select the file, then push **Open**.
4. Push **Select Sensors to Show**.
5. Put a check in the box of each parameter to look at in the *Time Series* graph.
6. Push **OK**.

10.4.3.3 ECO V2 data menu

Replay Data

Lets the user select a .sbsdat file to show in the *Time Series* window.

Data Analysis Filter

A six-step wizard that lets the user do a QAQC analysis of data.

QA Processed data

Select a .csv file type to make a graph of processed data.

10.4.4 View menu

Dashboards— Go to the **View** menu and *Dashboards* to select the dashboard for a specific sensor.

Graphs

- Time Series Graphs—all supported sensors.
- SeaFET—Processed pH graph.
- SUNA—Spectra, Absorbance, or Reprocessed Nitrate.
- SUNA Spectra graph: the user can push **Configure** to change the number of graphs to view. The "Graph History Limit" range is 1–2147483647. Put a check in the "Graph History Unbounded" box to see the total number of graphs. Default value: no check in the box and a "Graph History Limit" of 1.
- SUNA Absorbance graph: the user can change the "Min. Wavelength Cutoff" to between 150–400 nm to change the scale of the graph. Push **Configure** to change the number of graphs to view. The "Graph History Limit" range is 1–2147483647. Put a check in the "Graph History Unbounded" box to see the total number of graphs. Default value: no check in the box and a "Graph History Limit" of 1.
- SUNA Reprocessed Nitrate graph: the user may find that it helps to reprocess data under some conditions.

Output— Go to the **View** menu and select *Output*, then any of the three options:

- *Instrument Console*: the current settings in the sensor
- *Processing Console*: the data collected by the sensor in a comma-delimited format
- *Application Console*: the commands sent to the sensor from the software.

Real Time Data— Go to the **View** menu and select *Real Time Data* to select the parameters that the specific sensor will use for data collection.

Data Collection— Go to the **View** menu and select *Data Collection* to select the location on the PC in which the collected data is saved.

Acquisition Monitor— Used by the manufacturer for troubleshooting.

Message File— Used by the manufacturer for troubleshooting.

10.4.5 Window and Help menus

The user can change how the software shows different windows and tabs. The **Help** menu has the .pdf version of the user manuals for supported sensors and this software reference.

- *Close Current Window*—closes the selected tab (highlighted in blue).
- *Close all Windows*—closes all tabs except the UCI Dashboard.
- *Configure Window*—

Maximize: increases the size of the selected tab to fill the software screen size.

Float: unlocks the selected tab from the software screen so that the user can move it to other locations on the PC screen.

Float Groups: the same as *Float* above, but all tabs that are open are unlocked so that the user can move them to other locations on the PC screen.

Minimize: minimizes the selected tab and moves it to the side of the software screen.

Minimize Group: minimizes the open tabs in the "Console," "Dashboard," or "Graph" areas of the software.

Dock: locks the tab that the user selected to "float" back to its previous position in the software window.

Dock Group: the same as *Dock* above, but all tabs that are open are locked back into their previous position in the software window.

Section 11 General information

Revised editions of this user manual are on the manufacturer's website.

11.1 Warranty

Refer to the manufacturer's website for warranty information (seabird.com/warranty).

11.2 Service and support

The manufacturer recommends that sensors be sent back to the manufacturer annually to be cleaned, calibrated, and for standard maintenance.

Refer to the website for FAQs and technical notes, or contact the manufacturer for support at support@seabird.com. Do the steps below to send a sensor back to the manufacturer.

1. Complete the online Return Merchandise Authorization (RMA) form or contact the manufacturer.
Note: The manufacturer is not responsible for damage to the sensor during return shipment.
2. Remove all batteries from the sensor, if so equipped.
3. Remove all anti-fouling treatments and devices.
Note: The manufacturer will not accept sensors that have been treated with anti-fouling compounds for service or repair. This includes AF 24173 devices, tri-butyltin, marine anti-fouling paint, ablative coatings, etc.
4. Use the sensor's original ruggedized shipping case to send the sensor back to the manufacturer.
5. Write the RMA number on the outside of the shipping case and on the packing list.
6. Use 3rd-day air to ship the sensor back to the manufacturer. Do not use ground shipping.
7. The manufacturer will supply all replacement parts and labor and pay to send the sensor back to the user via 3rd-day air shipping.

11.3 Lithium battery shipment

⚠ WARNING

Do not ship the sensor with the batteries installed. Do not ship the battery pack for the sensor with the batteries installed.


The information below is general. It gives guidance only to appropriately trained shipping personnel. Refer to the IATA Dangerous Goods Regulations for complete information about shipping lithium batteries.

The manufacturer ships the lithium cells with the sensor in a separate box. Each of the 12 cells is packed in heat-sealed plastic. All batteries are packed in bubble wrap in a sturdy box.



General information

Batteries that are shipped without the sensor are Dangerous Goods. They can only be shipped by personnel with the appropriate training from an organization that has a Dangerous Goods program.

	Sensor, no spares	Sensor, 1 or 2 spare cell sets	Cells only
UN #	3091		3090
PI #	969		968
Passenger aircraft	yes	no	
Cargo aircraft	yes		
Label requirements	<div></div>		
	--	<div><div>LITHIUM METAL BATTERIES - FORBIDDEN FOR TRANSPORT ABOARD PASSENGER AIRCRAFT</div><div>677-275-2235 www.AsiLabeled.com</div></div>	

Appendix A Configure sensor for ECO "Classic" output

To use an ECO V2 where a "Classic" was used, configure the V2 output to look like the "Classic" output :

- The output is limited to approximately 20 bits (4130 maximum counts) using the ScaledRaw output
- The output is limited to ECO V2 high gain range
- The output does not have QAQC data.

When the sensor is in Legacy Mode, use the `MxLegacyRange` command to see the maximum range available for each measurement.

Use a terminal emulator program to change the output format of an ECO V2 to look like ECO "Classic." The commands below will put the ECO V2 into Legacy Mode so that the data collected is the same format and scaling of ECO Classic sensors.

Quick start steps:

Step 1: Enter Legacy Mode and select ECO Classic format with the sequence command.

Step 2: Select the range of the output for each channel.

Step 3: Look at and save the legacy calibration coefficients (dark counts and scale factors) for each channel.

Send the `$run`, `StartNow`, or `StartLater` (non-real-time sensors) command to start data collection.

A.1 Example setup

IMPORTANT

- The sensor cannot be in data collection mode while it is changed to or from legacy output.
- If the sensor is equipped with memory, the data will be stored in the ECO V2 format, with range, precision, QAQC, even if it is in Legacy Mode.
- The calibration coefficients below are different from those for normal ECO V2 operation. These calibration coefficients are legacy-dependent and **MUST** be recorded for each channel every time you enter Legacy Mode or change a Legacy Range.
- Legacy Mode commands use CAL 1 in the ECO V2 to scale the Legacy Counts. To set the output scaled to CAL 2, (to access an NTU calibration on a backscattering 700 nm measurement, for example), use the `MxSwapCal` command to change the locations of CAL 1 and CAL 2. The Legacy Mode commands can then access the second calibration, which is now in the CAL 1 location. Use the `GetCC` command to identify the locations and types of the calibrations.
- Commands, responses, and comments for Steps 1–3:
 - **Bold:** the command entered by the user, followed by `Enter`.
 - **Normal:** the response to the command.
 - **Italics:** the comments to the command.

A.1.1 Step 1: Enter Legacy Mode and select Classic output

Stop *Stops data collection*

`<!--sampling stopped-->` or `<Executed/>`

Enter *Push Enter to get the <Executed/> or ECOV2> response.*

`<Executed/>`

\$seq 0 *Enter legacy mode, set output to Sequence 0.*

\$seq 0 *Enter ' \$seq 0 ' again to confirm that Sequence 0 is the default ECO Classic output.*

Configure sensor for ECO "Classic" output

```
<$seq='0' />
```

```
<Executed/>
```

GetLegacyRanges

```
<LegacyRanges DeviceType='ECOV2' SerialNumber='10001'>
```

```
<LegacyRange measurement='1' id='CHL-470' max='400' units='µg/l'>400</LegacyRange>
```

```
<LegacyRange measurement='2' id='Backscattering-700' max='9.500000e-01'
units='m-1 sr-1'></LegacyRange>
```

```
<LegacyRange measurement='3' id='FDOM' max='900'
units='ppb'></LegacyRange></LegacyRanges>
```

```
<Executed/>
```

The current range, maximum range, and units show for each measurement.

A.1.2 Step 2: Select the output range for each channel

mxlegacyrange=1,100

Set range of measurement 1, CHL, to 100 µg/L.

```
<LegacyRange measurement='1' id='CHL' max='400' units='ug/l'>100</LegacyRange>
```

```
<Executed/>
```

Note: measurement 2 is not changed in this example.

mxlegacyrange=3,200

3=the number of the measurement to show

```
<LegacyRange measurement='3' id='FDOM' max='900' units='ppb'>200</LegacyRange>
```

```
<Executed/>
```

A.1.3 Step 3: Show and save the calibration coefficients

GetCC *Get the legacy range calibration coefficients*

```
<CalibrationCoefficients DeviceType='ECOV2' SerialNumber='10001'>
```

```
<!--Legacy Range = 100.0 ug/l-->
```

```
<SerialNum>10001</SerialNum>
```

```
<CalDate>1970-01-01</CalDate>
```

```
<Units>µg/l</Units>
```

```
<DarkCounts>50</DarkCounts> Dark counts for CHL.
```

```
<ScaleFactor>2.464461e-02</ScaleFactor> Scale factor for CHL.
```

```
</Calibration>
```

```
<Calibration format='ECO1' id='Backscattering-700' label='Beta-700'>
```

```
<!--Legacy Range=9.990000e-02 m-1 sr-1-->
```

```
<SerialNum>10001</SerialNum>
```

```
<CalDate>1970-01-01</CalDate>
```

```
<Units>m-1 sr-1</Units>
```

```
<DarkCounts>50</DarkCounts> Dark counts for bb-700.
```

```
<ScaleFactor>2.448539e-05</ScaleFactor> Scale factor for bb-700.
```

```
</Calibration>
```

```
<Calibration format='ECO1' id='FDOM' label='FDM'>
```

```
<!--Legacy Range = 200.0 ppb-->
  <SerialNum>10001</SerialNum>
  <CalDate>1970-01-01</CalDate>
  <Units>ppb</Units>
  <DarkCounts>50</DarkCounts> Dark counts for FDOM.
  <ScaleFactor>4.910981e-02</ScaleFactor> Scale factor for FDOM
</Calibration>
</CalibrationCoefficients>
<Executed/>
```

A.1.4 Stop ECO Classic output

Push the **Enter** key *Gives the executed response.*

```
<Executed/>
```

setLegacy=0 *Turn off the ECO Classic output*

```
<Executed/>
```

ts *Take a sample to make sure V2 output shows.*

```
ECOV2-10001 99:99:99 296 28 30000 1140 108 30250 829 79 30500 0 0 0 14.50 111222221
41414
```

```
<Executed/>
```

A.2 Legacy mode commands

Command	Response
\$Seq X	Enter Legacy Mode and set the output to Sequence Number X. Sequence numbers are output formats where X=0 for standard ECO Classic, X=1 for short, X=2 for long. This command requires a command confirmation.
GetLegacyRanges	Show the current Legacy Range settings.
MxLegacyRange=m,r	Set the maximum output range for measurement m to range r.
MxDeleteLegacy=m	Disable the legacy real-time output for a single measurement, m. The measurement m is still recorded. Used to disable a measurement output for a 4-measurand ECO V2 when data is collected with a CTD that can only take three serial measurements as input. Note that it is possible to accidentally turn off all measurement output. Use \$seq or SetLegacy=1 to turn them all back on.
GetCC	Get the dark counts and scale factor for the current Legacy Range setting for each channel. Engineering output = (LegacyCounts - DarkCounts) × ScaleFactor
MxSwapCal=m	Changes calibrations 1 and 2 for measurement m. This setting will be kept when the power is turned off, then on.
SetLegacy	Get the current Legacy Mode status.
SetLegacy=0	Turn off Legacy Mode and set output to manufacturer defaults.
SetLegacy=1	Turn on Legacy Mode. Turn on all measurements for output in, and set output to Sequence 0. Requires a command confirmation.

A.3 Legacy output formats

Output sequences and formats

- RefX = reference wavelength
- SigX = signal in legacy counts
- SN = serial number of the sensor
- Temp = internal processor temperature measurement
- SFX = legacy scale factor
- DCX = legacy dark counts

Use the sequence command and a sequence number to enable a format. There are three Classic output formats:

- **Sequence 0, Standard (default)**
99/99/99 99:99:99 Ref1 Sig1 Ref2 Sig2 Ref3 Sig3 Ref4 Sig4 Temp
- **Sequence 1, Short**
Sig1 Sig2 Sig3 Sig4 SN
- **Sequence 2, Long**
Sig1 Sig2 Sig3 Sig4 SN SF1 DC1 SF2 DC2 SF3 DC3 SF4 DC4

Notes on output

- The default output has all measurements turned on, is fixed-width and tab-delimited.
- Full range is 4130 counts.
- The minimum, or dark count, value is always 50.
- Temperature is always a 999 placeholder to align the number of fields from the ECO Classic.
- When a sequence number is selected, all measurements are enabled.
- Use the `MxDeleteLegacy` command to disable one or more of the outputs from the data. Once a measurement output is disabled, you must enter a sequence command again to restore all output.

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