ECO FLNTU Puck

User's Guide

This user's guide is an evolving document. If you find sections that are unclear or missing information, please let us know. Please check our website periodically for updates.

WET Labs, Inc.
PO Box 518
Philomath, OR 97370
(541) 929-5650
www.wetlabs.com

ECO Sensor Warranty

This unit is guaranteed against defects in materials and workmanship for one year from the original date of purchase. Warranty is void if the factory determines the unit was subjected to abuse or neglect beyond the normal wear and tear of field deployment, or in the event the pressure housing has been opened by the customer.

To return the instrument, contact WET Labs for a Return Merchandise Authorization (RMA) and ship in the original container. WET Labs is not responsible for damage to instruments during the return shipment to the factory. WET Labs will supply all replacement parts and labor and pay for return via 3rd day air shipping in honoring this warranty.

Return Policy for Instruments with Anti-fouling Treatment

WET Labs cannot accept instruments for servicing or repair that are treated with anti-fouling compound(s). This includes but is not limited to tri-butyl tin (TBT), marine anti-fouling paint, ablative coatings, etc.

Please ensure any anti-fouling treatment has been removed prior to returning instruments to WET Labs for service or repair.

Shipping Requirements

1. Please retain the original shipping material. We design the shipping container to meet stringent shipping and insurance requirements, and to keep your meter functional.

2. To avoid additional repackaging charges, use the original box (or WET Labs-approved container) with its custom-cut packing foam and anti-static bag to return the instrument.
   - If using alternative container, use at least 2 in. of foam (NOT bubble wrap or Styrofoam "peanuts") to fully surround the instrument.
   - Minimum repacking charge for ECO meters: $25.00.

3. Clearly mark the RMA number on the outside of your shipping container and on all packing lists.

4. Return instruments using 3rd day air shipping or better: do **not** ship via ground.

Electrical equipment marked with this symbol may not be disposed of in European public disposal systems. In conformity with EU Directive 2002/96/EC (as amended by 2003/108/EC), European users of electrical equipment must return old or end-of-life equipment to the manufacturer for disposal at no charge to the user.

1. Overview

ECO pucks are custom instruments available with a variety of options in a single basic design. Please refer to the Appendix for the specifications that apply to your meter.

ECO pucks are delivered with the following components:

- the instrument
- this user's guide
- instrument-specific calibration sheet
- protective cover for optics
- fluorescent stick for bench testing

2. Theory of Operation

The *Environmental Characterization Optics* (*ECO)* combination fluorometer and turbidity sensor allows the user to measure chlorophyll fluorescence at 470 nm and turbidity at 700 nm within the same volume.

The fluorometer allows the user to monitor chlorophyll concentration by directly measuring the amount of chlorophyll-*a* fluorescence emission from a given sample volume of water. Chlorophyll, when excited by the presence of an external light source, absorbs light in certain regions of the visible spectrum and re-emits a small portion of this light as fluorescence at longer wavelengths. Blue LEDs (centered at 470 nm and modulated at 1 kHz) provide the excitation source. The blue light from the sources enters the water volume at an angle of approximately 55–60 degrees with respect to the end face of the unit. Fluoresced light is received by a detector positioned where the acceptance angle forms a 140-degree intersection with the source beam. A red interference filter is used to discriminate against the scattered blue excitation light. The red fluorescence emitted is synchronously detected by a silicon photodiode.

Turbidity is measured simultaneously by detecting the scattered light from a 700 nm LED at 140 degrees to the same detector used for fluorescence. The turbidity measurement is performed at the same 140 degree angle as the chlorophyll fluorescence.

3. Instrument Operation

Please note that certain aspects of instrument operation are configuration-dependent. These are noted where applicable within the manual.

3.1 Initial Checkout

Supplied from the factory, *ECO*s are configured to begin continuously sampling upon power-on. Electrical checkout of *ECO* is straightforward.

WARNING!
Always use a regulated power supply to provide power to ECO sensors. Power spikes may damage the meter.

Connect the instrument to a regulated power supply; when turned on, light should emanate from the meter.

Note
ECO scattering meters are sensitive to fluorescent light. Before making measurement, turn AC lighting off.

3.2 Deployment

The meter is ready for submersion and subsequent measurements when power is supplied. Some consideration should be given to the package orientation. Do not face the sensor directly into the sun or other bright lights. For best output signal integrity, locate the instrument away from significant EMI sources.

Caution
The ECO meter should be mounted so that the red LED source will not "see" any part of a cage or deployment hardware. This will affect the sensor's output.

Other than these basic considerations, one only needs to make sure that the unit is securely mounted to whatever lowering frame is used and that the mounting brackets are not damaging the unit casing.

3.3 Upkeep and Maintenance

The *ECO* FLNTU is compact device and its maintenance can be easily overlooked. However, it is a precision instrument and does require a minimum of routine upkeep. After each cast or exposure of the instrument to natural water, flush the instrument with clean fresh water, paying careful attention to the sensor face. Use soapy water to cut any grease or oil accumulation. Gently wipe clean with a soft cloth. The sensor face is composed of ABS plastic and optical epoxy and can easily be damaged or scratched. When not in use, make sure the protective cap is secured to the face.

WARNING!
Do not use acetone or other solvents to clean the sensor.

After any experiment, the instrument should be rinsed thoroughly, air-dried and stored in a cool, dry place.

4. Data Analysis

Data from the *ECO* fluorometer and turbidity sensor represents raw output from the sensor. Applying linear scaling constants, this data can be expressed in meaningful forms of chlorophyll fluorescence and NTUs. Use the Scale Factor provided on the characterization sheet that ships with your meter to calculate these values.

Chlorophyll
Scale Factor = *x* µg/l ÷ (Chl Equivalent Concentration – dark counts)
Example: 25 ÷ (3198 – 71) = 0.0080.

NTU
NTU*xx* = Scale Factor x (ECO counts – dark counts) where *xx* is the value of a Formazin concentration.

The *ECO* FLNTU response is linear over the measurement range provided. The instruments have a chlorophyll measurement range of approximately 0.02 to 50.0 µg/l and an NTU measurement range of approximately 0–25. Because of the varied environments in which each user will work, it is important to do calibrations using similar seawater as you expect to encounter *in situ.* Please refer to characterization section for further details. This will provide an accurate blank, equivalent phytoplankton types and similar physiological conditions for calculating the scale factor, thereby providing an accurate and meaningful calibration. Once a zero point has been determined and a scale factor established, the conversion of counts to chlorophyll concentration and NTUs is straightforward using the equations:

Chlorophyll: $[Chl]_{sample} = (C_{output} - C_{dc}) * \text{Scale Factor}$

where $[Chl]_{sample}$ = concentration of a chlorophyll sample of interest (µg/l)
C_{output} = output when measuring a sample of interest (counts)
C_{dc} = measured signal in clean water with black tape over detector (dark counts)
Scale factor = multiplier in µg/l/counts.

NTU: $[NTU]_{sample} = (NTU_{output} - NTU_{dc}) * \text{Scale Factor}$

where $[NTU]_{sample}$ = concentration of NTU solution
NTU_{output} = output when measuring a sample of interest (counts)
NTU_{dc} = measured signal of clean water with black tape over detector (dark counts) in raw counts
Scale factor = multiplier in NTU/counts.

5. Characterization and Testing

ECO FLNTU is configured for a chlorophyll measurement range of 0.02–50 µg/l. The turbidity sensor's measurement range is 0–25 NTU. Gain selection is done at WET Labs by setting several gain settings inside the instrument, and running a dilution series to determine the zero voltage offset and to ensure that the dynamic range covers the measurement range of interest. The dilution series also establishes the linearity of the instrument's response. As is the case with other fluorometers, each user should perform a detailed characterization to determine the actual zero point and scale factor.

The tests below ensure the meter's performance

1. **Dark Counts**: The meter's baseline reading in the absence of source light is the dark count value. This is determined by measuring the signal output of the meter in clean, de-ionized water with black tape over the detector.

2. **Pressure**: To ensure the integrity of the housing and seals, *ECO*s are subjected to a wet hyperbaric test before final testing. The testing chamber applies a water pressure of at least 40 PSI.

3. **Mechanical Stability**: Before final testing, the *ECO* meters are subjected to a mechanical stability test. This involves subjecting the unit to mild vibration and shock. Proper instrument functionality is verified afterwards.

4. **Electronic Stability**: This value is computed by collecting a sample once every second for twelve hours or more. After the data is collected, the standard deviation of this set is calculated and divided by the number of hours the test ran. The stability value must be less than 2 counts.

5. **Noise**: The noise value is computed from a standard deviation over 60 samples. These samples are collected at one-second intervals for one minute. A standard deviation is then performed on the 60 samples, and the result is the published noise on the characterization sheet. The calculated noise must be below 2 counts.

6. **Voltage and Current Range Verification**: To verify that the *ECO* operates over the entire specified voltage range (7–15 V), a voltage test is performed at 7 and 15 V. The meter is operated at these settings and the current and operation is observed. The current must remain constant at both 7 and 15 volts.

6. Terminal Communications

ECO sensors can be controlled from a terminal emulator or customer-supplied interface software. This section outlines hardware requirements and low-level interface commands for this type of operation.

6.1 Interface Specifications

- baud rate: 19200
- data bits: 8
- parity: none
- stop bits: 1
- flow control: none

6.2 Command List

Command	Parameters passed	Description
!!!!!	none	Stops data collection; allows user to input setup parameters.
$ave	single number, 1 to 65535	Number of measurements for each reported value.
$mnu	none	Prints the menu.
$pkt	single number, 0 to 65535	Number of individual measurements in each packet.
$rls	none	Reloads settings from flash.
$run	none	Executes the current settings.
$sto	none	Stores current settings to internal flash.

7. Output File Format

Date (MM/DD/YY)	Time (HH:MM:SS)	N/U	CHL Signal	N/U	NTU Signal	Thermistor
99/99/99	99:99:99	1817	49	1583	69	536
99/99/99	99:99:99	1818	48	1583	68	536
99/99/99	99:99:99	1818	49	1583	68	536
99/99/99	99:99:99	1818	49	1583	67	536
99/99/99	99:99:99	1818	47	1583	69	536
99/99/99	99:99:99	1819	48	1584	68	536

(Date and Time are not applicable on pucks: the 9's are placeholders.)

WET Labs WEEE Policy

In accordance with Directive 2002/96/EC and the Council of 27 January 2003, WET Labs policy regarding the collection and management of Waste Electrical and Electronic Equipment (WEEE) is published here and is available at www.wetlabs.com.

A core component of our corporate vision is to accept responsibility for preserving our environment and we embrace the opportunity to work with our customers and the EU to reduce the environmental impact resulting from the continuous improvement of our products.

WEEE Return Process

To meet the requirements of the WEEE Directive, WET Labs has instituted a product end-of-life take back program. To arrange return for an end-of-life WEEE product:

1. Contact WET Labs Customer Service
   - By phone: 1-541-929-5650
   - By email: support@ wetlabs.com

   WET Labs will provide:
   WEEE RMA number
   Shipping account number, method, and address

2. Package and ship the WEEE back to WET Labs

WEEE will be processed in accordance with WET Labs' equipment end-of-life recycling plan.

Revision History

Revision	Date	Revision Description	Originator
1	7/29/05	Draft new document	M. Johnson
A	8/31/05	Approved document (DCR 472)	M. Johnson
B	12/7/05	Clarify Scale Factor and output, sections 4, 5, 7 (DCR 477)	H. Van Zee, R. Watte, C. Wetzel
C	1/13/06	Clarify warranty statement (DCR 481)	A. Gellatly, S. Proctor
D	2/7/06	Move specifications to individual appendices (DCR 485)	H. Van Zee
E	7/10/08	Change dark counts derivation to reflect current production methodology (DCR 600)	A. Barnard, M. Johnson, H. Van Zee
F	5/7/09	Delete references to ECOView, device files (DCR 666)	M. Johnson, H. Van Zee
G	9/14/11	Add WEEE Statement (DCN 775)	H. Van Zee