

ECO User Guide

I. Instrument Configuration Options

A. There are four categories of ECO sensors:

1. Fluorometers (FL, FLCD, FLPE, FLPC, FLRH)
2. Back scattering sensors (BB)
3. Turbidity sensors (NTU)
4. PAR sensors (PAR)

B. Optics Configurations

1. Single channel (FL, BB, NTU, PAR). NOTE: PAR is only available in a single channel configuration, it cannot be combined with other sensors
2. Two channel - FLNTU, FLBB, FLCDBB, ECO Puck
3. Three channel - combinations of FL & BB, ECO Puck

C. Functional Modes

1. Self-logging (i.e. FL or BB)
 - a) Has a Date column (mm/dd/yy, non-configurable)
 - b) Has a Time Column (hh:mm:ss, non-configurable)
 - c) Simultaneous data recording and data output via serial RS-232
 - d) The memory is not over-written, once full
 - e) Number of records available for different number of output channels:
 - i. Single channel – 108,000 records (lines)
 - ii. Two channel – 90,000 records
 - iii. Three channel – 77,000 records
2. Real-time (i.e. FLRT or BBRT)
 - a) Has a **non-configurable** “99/99/99” date column format (space holder)
 - b) Has a **non-configurable** “99:99:99” time column format (space holder)
 - c) Does NOT record data

NOTE: these modes have different electronic board sets and firmware:

D. Anti bio-fouling shutter and faceplate

1. Denoted by an “S” (Shutter) in the serial number (i.e. FLS or BBS)
2. Has a copper shutter and faceplate to passively keep marine organisms from attaching to the active optics area.
3. The shutter covers the active optics area, rotating open/closed (180 degrees) to take measurements on a configurable interval. NOTE: the shutter opens and closes between each sampling interval.
4. The shutter has a rubber wiper to clean the active optics area

E. Self-powered (internal battery pack)

1. Denoted by a “B” (Battery) in the serial number (i.e. FLSB or BBSB)

2. A second bulkhead connector (MCBH-3-MP) is used with a special dummy plug ("jumper") to engage the internal battery pack, when inserted. When the "jumper" is inserted, the ECO starts sampling, as when powered ON externally.
3. The internal pack has six (6) +9V Lithium Manganese Dioxide batteries.
4. Internal battery units can be externally powered, bypassing the internal battery.

NOTE: the internal battery pack and external power connections are diode protected against reverse-power.

II. Basic Operational Overview

- A. The ECO automatically starts sampling when powered ON, transmitting data records (serial RS-232) and voltages (1 & 2 channel instruments only, analog output (0-5V)).
- B. One "sample" consists of sixteen (16) averaged LED ON/OFF cycles. The LED's are switched at 1.4kHz.
- C. An ECO setup parameter ("Ave") groups a set number of "samples" (as described in #2) for each data record. The factory default "Ave" setting:
 1. Sends data output at 1 Hz.
 2. Varies depending on the ECO optics configuration (1, 2, or 3 channel).
 3. The approximate "Ave" value for the default (1 Hz) output for each optics configuration:
 - a) 1 channel: ~58
 - b) 2 channel: ~30
 - c) 3 channel: ~18
- D. The data is transmitted via the serial RS-232 output line and stored into memory (if the "Record" parameter is set). The serial RS-232 communication configuration is:
 1. 19200 baud (some earlier units ("DFL" serial numbers) use 9600)
 2. 8 data bits
 3. No parity
 4. 1 stop bit
 5. No flow control (hardware)
- E. The baud rate is NOT field-configurable. It is set at 19200 baud.

NOTE: There are other slower baud rates available, if required... but, these are also hard-configured in the firmware. I will find out if these can be increased.

- F. The serial data stream and analog voltage signal (0-5V) are available, simultaneously.
- G. The memory capacity is not expandable. The single channel ECO has on-board static RAM with enough capacity for 108,000 records.

NOTE: The additional output fields on the 2 & 3-channel ECO's reduce the total number of records: 90,000 (2-channel); 77,000 (3-channel).

- H. The ECO needs to be stopped, in Standby, to change the settings or download data from memory.

III. Manual Commands

A. Command Structure

1. All manual commands begin with a "\$" character, followed by a 3 letter mnemonic followed by <enter> (also known as "carriage return-line feed" <CR><LF>).
2. If the command is changing an instrument setting/parameter, the command has the "\$", the mnemonic, a space (or "=" character), and the argument... followed by <enter>.
3. All settings need to be **STORED** to Flash memory, using the "\$sto<enter>" command.
4. The case is NOT sensitive, upper or lower cases are the same.

B. Command Overview

1. The deployment parameter settings (and commands) are:
 - a) **Pkt** - # of samples (i.e. "\$pkt 15<enter>" or "\$pkt=15<enter>") NOTE: "0" is used for continuous output.
 - b) **Set** - # of cycles; (i.e. "\$set=50000<enter>") NOTE: this parameter is disregarded if "Pkt" is "0"; it can also be set to "0" for continuous sets (no limit).
 - c) **Cal** - engineering output column (ug/l) enable/disable (1/0); (\$cal=1<enter>).
 - d) **Rec** - memory enable/disable (1/0); (\$rec=1<enter>).
 - e) **Int** - cycle interval, time between "Set" (hhmmss, < 240000); (\$int 001000<enter> (10 mins)).
 - f) **Dat** - date, mmddyy; (\$dat 121814<enter> (December 18, 2014)).
 - g) **Clk** - time, hh:mm:ss; (\$clk 172500<enter> (5:25 pm)).
 - h) **Ave** - this parameter defines the number of sample groups to be used (as described in the Basic Operation section above).
2. Data management:
 - a) **Get** - sends the contents of memory in ASCII (text) format; (\$get<enter>).
 - b) **Emc** - clears the memory (erase memory counter): "\$emc<enter>".
3. To interrupt (Stop) the sensor:
 - a) "!!!!!!..." - stop command (series of exclamation marks (>5)).
 - b) The Stop command puts the ECO into Standby.
 - c) When the Stop command is successfully interpreted by the ECO, the sampling stops and the deployment parameter settings are displayed/listed. The listing of parameters is referred to as the "Menu".
4. To display the deployment parameter settings:

Mnu – list of the deployment parameter settings (instrument is in Standby); (\$mnu<enter>).
5. To start the sensor (if in Standby):

Run - restart the sampling; (\$run<enter>).

NOTE: the "Run" command is NOT necessary when the ECO is first powered ON.

IV. Data format

A. Data Overview

1. The data records are written to memory in binary format, downloaded as a converted ASCII output.
2. The output record of the single-channel ECO contains the following columns of ASCII characters:
Date, Time, Signal header, Signal measurement, Therm
3. Each column is "Tab" delimited. **NOTE: the data should be read using Tab-delimited parsing, since the columns are NOT (all) fixed-width.**
4. Each record ends with a <CR><LF>
5. The "Signal measurement" column varies between 2 - 5 bytes, depending on the magnitude of the signal
6. "Date" & "Time" columns are 8 bytes
7. "Signal header" & "Therm" columns are 3 bytes
8. The "Therm" column is NOT a calibrated signal. It is used for factory diagnostics, but does not have a physical temperature characterization performed. It is an on-board (internal) CPU chip thermistor signal. It varies inversely to the internal temperature of the ECO, between 480 - 600 counts (~530 for room temperature, 23C).
9. Additional optics channels add two columns per channel to the output record, preceding the "Therm" (last) column. For example, a 2-channel (i.e. FLNTU) adds an "NTU header" and an "NTU signal" following the "Signal measurement" column and before the "Therm" column (#2, above).
10. The engineering output column ("CHL engr", enabled with the "Cal" parameter set up variable, as described previously) varies between 4 - 6 bytes, depending on the magnitude of the signal.

B. Triplet Signal Channel Designations

1. If all three channels are fluorometers:
 - a) the first column pair will always be chl-a (if present).
 - b) the third column pair will always be CDOM (if present).
 - c) emission (Em) wavelength in ascending order, assigned to ascending channel designations (respectively). NOTE: this is FOLLOWING the "chl-a" channel pair (always #1, if present) or preceding the "CDOM" channel pair (always #3, if present).
 - d) the example FL3 output that you posted (from my example) should be corrected as:

Date (mm/dd/yy), Time (hh:mm:ss), FLPE header(595), FLPE signal, FLPC header(680), FLPC signal, CDOM header(460), CDOM signal, Therm<CR><LF>

2. If all three channels are scattering meters:
 - a) the scattering wavelengths in ascending order, assigned to ascending channel designations (respectively).
 - b) the example BB3 output:

Date (mm/dd/yy), Time (hh:mm:ss), BB header(488), BB signal(488), BB header(532), BB signal(532), BB header(650), BB signal(650), Therm<CR><LF>

3. If there is a combination of scattering meters and fluorometers:

- the scattering wavelenth(s) are assigned FIRST, according to "B" (above).
- the fluorometers are assigned SECOND, according to "A", except chl-a is never in position #1, but will be the first fluorometer channel... position #2 (if two fluorometers) or #3 (if 2 scattering).
- the example BBFL2 output (BB(650), chl-a, CDOM):

Date (mm/dd/yy), Time (hh:mm:ss), BB header(650), BB signal(650), CHLA header(695), CHLA signal, CDOM header(460), CDOM signal, Therm<CR><LF>

- the example BB2FL output (BB(440), BB(650), chl-a):

Date (mm/dd/yy), Time (hh:mm:ss), BB header(440), BB signal(440), BB header(650), BB signal(650), CHLA header(695), CHLA signal, Therm<CR><LF>

C. Format examples

1. ECO chlorophyll-a fluorometer (FL) columns:

Date, Time, CHL header, CHL signal, Therm

Example:

01/28/14	15:29:43	695	47	531
01/28/14	15:29:44	695	48	531

2. ECO FL Columns w/ "Engr" output (Cal) enabled:

Date, Time, CHL engr, CHL header, CHL signal, Therm

Example:

12/18/14	23:05:17	129.02	695	16380	537
12/18/14	23:05:18	129.02	695	16380	537

3. ECO FLNTU Columns:

Date, Time, CHL header, CHL signal, NTU header, NTU signal, Therm

Example:

04/21/15	11:34:51	695	50	700	52	530
04/21/15	11:34:52	695	50	700	52	530

4. ECO BBFL2 Columns:

Date, Time, BB header, BB signal, CHL header, CHL signal, CDOM header, CDOM signal, Therm

Example:

05/19/15	12:00:45	700	50	695	52	460	50	535
05/19/15	12:00:46	700	50	695	52	460	49	535

V. Miscellaneous

- A. The ECO's ship with a 6-pin MCBH-6-MP host power & I/O connector.
- B. Test cables are available. The test cables have a standard serial RS-232 (DB-9) connector serial. A test cable option is available for measuring the analog voltage output on the 1 & 2-channel instruments.
- C. The ECO Triplet does not have any analog voltage outputs.