PME

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Cyclops-7 Logger

USER'S MANUAL

PME

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WARRANTY

Limited Warranty

Precision Measurement Engineering, Inc. ("PME") warrants the following products to be, as of the time of shipment, free from defects in materials or workmanship under normal use and conditions for the period indicated below corresponding to the product. The warranty period commences on the original date of purchase of the product.

Product	Warranty Period
Aquasend Beacon	1 year
miniDOT Logger	1 year
miniDOT Clear Logger	1 year
miniWIPER	1 year
miniPAR Logger (Logger only)	1 year
Cyclops-7 Logger (Logger only)	1 year
C-FLUOR Logger (Logger only)	1 year
T-Chain	1 year
MSCTI (excludes CT/C-sensors)	1 year
C-Sense Logger (Logger only)	1 year

For valid warranty claims made and covered defects existing during the applicable warranty period, PME will, at PME's option, repair, replace (with the same or then most similar product) or repurchase (at purchaser's original purchase price), the defective product. This warranty extends solely to the original end-user purchaser of the product. PME's entire liability and the sole and exclusive remedy for product defects is limited to such repair, replacement or repurchase in accordance with this warranty. **This warranty is provided in lieu of all other warranties express or implied, including, but not limited to warranties of fitness for a particular purpose and warranties of merchantability.** No agent, representative, or other third party has any authority to waive or alter this warranty in any way on behalf of PME.

WARRANTY EXCLUSIONS

The warranty does not apply in any of the following circumstances:

I) The product has been altered or modified without PME's written authorization,

II) the product has not been installed, operated, repaired, or maintained in accordance with PME's instructions, including, where applicable, use of proper grounding to an earth ground source,

III) the product has been subjected to abnormal physical, thermal, electrical, or other stress, internal liquid contact, or misuse, neglect, or accident,

IV) the product failure occurs as a result of any cause not attributable to PME,

V) the product is installed with ancillary devices such as flow sensors, rain switches, or solar panels that are not listed as compatible with the product,

VI) the product is installed in a non-PME specified enclosure or with other incompatible equipment,

VII) to address cosmetic issues such as scratches or surface discoloration,

VIII) operation of the product in conditions other than that for which the product was designed,

IX) the product has been damaged due to events or conditions such as caused by lightning strikes, power surges, unconditioned power supplies, floods, earthquakes, hurricane, tornados, vermin such as ants or slugs or intentional damage, or

X) products provided by PME, but manufactured by a third-party company, which products are subject to the applicable warranty extended by their manufacturer, if any.

There are no warranties that extend beyond the above limited warranty. In no event is PME responsible or liable to purchaser or otherwise for any indirect, incidental, special, exemplary, or consequential damages, including, but not limited to, lost profits, loss of data, loss of use, business interruption, loss of good will, or cost of procuring substitute products, arising out of or in relation to the product, even if advised of the possibility of such damages or losses. Some states do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply. This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

WARRANTY CLAIM PROCEDURES

A warranty claim must be initiated within the applicable warranty period by first contacting PME at info@pme.com to obtain an RMA number. The purchaser is responsible for proper packaging and return shipment of the product to PME (including shipping expense and any related duties or other costs). The issued RMA number and purchaser's contact information must be included with the returned product. PME is NOT liable for loss or damage of the product in return transit and recommends that the product be insured for its full replacement value.

All warranty claims are subject to PME's testing and examination of the product to determine if the warranty claim is valid. PME may also require additional documentation or information from the purchaser to evaluate the warranty claim. Products repaired or replaced under a valid warranty claim will be shipped back to the original purchaser (or its designated distributor) at PME's expense. If the warranty claim is found to be not valid for any reason, as determined by PME in its sole discretion, PME will notify the purchaser at the contact information provided by the purchaser.

SAFETY INFORMATION

Bursting Hazard

Should water enter the Cyclops-7 Logger and meet the enclosed batteries, then the batteries may generate gas causing the internal pressure to increase. This gas will likely exit via the same location where the water entered, but not necessarily. The Cyclops-7 Logger is designed to release internal pressure as the end cap is unscrewed, prior to the disengagement of the end cap threads. If internal pressure is suspected, then treat the Cyclops-7 Logger with extreme caution.

CHAPTER 1: QUICK START

1.1 Calibrate and Go

PME produces two types of loggers, a logger with the sensor permanently installed and a logger with a connector that you will use to plug in your own sensor. Even if the sensor is already installed, the logger/sensor are provided to you in an uncalibrated state. The logger itself is set to measure temperature and concentration once every 10 minutes and record 1 file of measurements daily. However, you must calibrate the sensor before the system can be used. At one measurement every 10 minutes the Cyclops-7 Logger will operate for roughly a half year before the internal battery is expended.

At the end of the deployment period you need only to open the logger and connect it to a host device via USB. The Cyclops-7 Logger will appear as a 'thumb drive'. Your temperature and sensor measurements, together with a time stamp indicating the time the measurement was made, are recorded in text files in the folder having the serial number of your Cyclops-7 Logger. These files can be copied onto any Windows or Mac host computer.

This Manual and other software is supplied in files on the Cyclops-7 Logger:

- CYC7CONTROL: Allows you to see the state of the logger as well as set the recording interval.

- CYC7PLOT: Allows you to see plots of the recorded measurements. C7Concatenate gathers all the daily files into one CAT.txt file.

When not connected to USB, your Cyclops-7 Logger will record measurements if the Recording Control Switch is in the Record position. If you wish to stop recording, switch the Recording Control Switch to the Halt position.

You may switch the Recording Control Switch at any time.

Follow these steps to start the deployment, logging Cyclops-7 output and Temperature once each 10 minutes:

1. Install your sensor onto the logger if required as described in Chapter 3.

2. Calibrate the sensor/logger as described in Chapter 2, Cyc7Control program.

3. Open the Cyclops-7 Logger (if not already open from calibration) as described in Chapter 3.

4. Switch the Recording Control Switch to the Record position. The LED will flash green 5 times.

5. The Cyclops-7 Logger will now record a measurement of time, battery voltage, temperature, and sensor output every 10 minutes (or at some other interval you may have set using Cyc7Control).

6. Inspect the o-ring seal for debris.

7. Close the Cyclops-7 Logger by screwing the white housing back onto the black end cap.

8. Deploy the Cyclops-7 Logger.

Follow these steps to end the deployment:

1. Recover the Cyclops-7 Logger

2. Clean and dry all accessible surfaces.

3. Open the Cyclops-7 as described in Chapter 3.

4. Connect to a Windows host computer via USB. The Cyclops-7 Logger will appear as a 'thumb drive'.

5. Copy the folder having the same serial number as the Cyclops-7 Logger (example 7377-191770) to the host computer.

6. (Suggested, but optional) Delete the measurement folder, but NOT Cyc7Control or the other .jar programs or manual.

7. (Optionally) run the Cyc7Plot program to see a plot of measurements.

8. (Optionally) Run the C7Concatenate program to gather all the daily files of measurements into one CAT.txt file

9. If no more recording is desired, switch the Recording Control Switch to Halt, otherwise leave it set to Record to begin recording after USB disconnection.

10. Disconnect the Cyclops-7 Logger from the USB connection.

11. Inspect the o-ring seal for debris.

12. Close the Cyclops-7 Logger by screwing the white housing back onto the black end cap.

13. Remove the batteries if storing the Cyclops-7 Logger for extended periods.

1.2 A Few Details

The previous section gives instructions for sampling at 10-minute intervals. However, there are a few additional details that will enhance use of the Cyclops-7 Logger.

SENSOR GUARD

The sensor guard is the long tube having slots in the end that covers the Turner C7 sensor. This guard not only protects the sensor but also establishes a consistent field of view for the sensor. The guard must be used when the sensor is calibrated and also when it is used for measurements in the field.

SAMPLING RATE

The Cyclops-7 Logger records measurements at equal time intervals. The default time interval is 10 minutes. However, it is also possible to instruct the Cyclops-7 Logger to record at different intervals. This is accomplished by connecting a Windows computer to the logger and using the Cyc7Control program supplied for this purpose. Recording intervals must be 1 or more minutes and must be less than or equal to 60 minutes. Intervals outside this range will be rejected by Cyc7Control. (Contact PME for other recording intervals.) Please refer to Chapter 2 for instructions on operating the Cyc7Control program.

TIME

All Cyclops-7 Logger times are UTC (formerly known as Greenwich mean time (GMT)). The Cyclops-7 Logger internal clock will drift in the < 10 ppm range (<about 30 seconds/month) so you should plan to connect it occasionally to a host having an internet connection. The Cyc7Control program will automatically set time based on an internet time server. Please refer to Chapter 2 for instructions on operating the Cyc7Control program.

FILE INFORMATION

The Cyclops-7 Logger software creates 1 file daily on the Cyclops-7 Logger's internal SD card. The number of measurements in each file will depend upon the sample interval. Files are named by the time of the first measurement within the file based on the logger's internal clock and expressed in YYYY-MM-DD HHMMSSZ.txt format. For example, a file having the first measurement on September 9, 2020 at 17:39:00 UTC will be named:

2020-09-09 173900Z.txt

Files can be uploaded from the Cyclops-7 Logger by connecting the Logger to a host computer and by using the host computer to copy/past the files from Logger to some host computer storage.

Each measurement within files has a time stamp. The time stamp format is Unix

Epoch 1970, the number of seconds that have passed since the first moment of 1970. This may be inconvenient in some cases. If so, the C7Concatenate software not only concatenates all the measurement files but also adds more readable statements of the time stamp.

Please refer to Chapter 2 for instructions on operating the C7Concatenate program.

The Cyclops-7 Logger requires time and battery energy to work through the file directory on SD card to allocate new file space. A few hundred files on SD is not a problem, but as the number of files grows large into the thousands the Logger may suffer decreased battery life or other performance problems. Please, at the earliest convenient time, copy recorded files to a host computer and delete them from the Logger. Also, do not use the Logger to store files unrelated to Logger operation.

CLEANING THE SENSOR

The sensor may be cleaned by unscrewing the black sensor guard and gently wiping the optical face.

BATTERY LIFE

The Cyclops-7 Logger consumes battery power mostly from the Cyclops-7 sensor, but also slightly from simply keeping track of time, writing files, sleeping, and other activities. The Cyclops-7 Logger will record approximately 30,000 total samples and will operate for up to a year (depending on sample interval) when powered by the battery pack (2 X alkaline 'C' cells) supplied by PME.

Keep a general record of Cyclops-7 Logger number of samples. It is not possible to accurately determine the charge state of the battery pack from measurements of its terminal voltage. If you have a general idea of the number of samples already obtained on a battery, then you can make a guess as to how many more samples remain. Err on the side of caution.

The 2 X 'C' battery pack holds the batteries very tightly. The holder itself is glued to the aluminum chassis. Take care when changing batteries that the glue joint is not broken. Always use the paper tube supplied with the Cyclops-7 to contain the batteries. Use only new batteries as replacements.

COIN CELL BATTERY LIFE

The Cyclops-7 Logger uses a coin cell for backup of the clock when the power is switched off. This coin cell will supply roughly 2 years of clock operation, but this is only required if the main power is off. Should the coin cell discharge it must be replaced. Coin cells are not user replaceable.

O-RING AND SEAL

When the cover is screwed on, it passes along the o-ring located in the end cap several revolutions. Keep this o-ring lightly lubricated with silicone grease or oil compatible with buna-N o-ring material.

When the Cyclops-7 Logger is opened after deployment, a small number of water drops are deposited on the inner surface of the o-ring. When the pressure housing is screwed back on, these drops become trapped inside the Cyclops-7 Logger. Be sure to carefully dry the o-ring and adjacent surfaces (especially underneath) prior to closing the Cyclops-7. Re-lube the o-ring at this time. Remove any debris from the drying process.

CLOSING THE LOGGER

The logger is much more difficult to open than to close. Screw the white logger housing onto the black cap until the housing touches the cap. No further tightening is necessary.

LED INDICATIONS

The Cyclops-7 Logger performs various tests as it begins logging operations. If any test fails, the software flashes the LED light and re-conducts the test. In general, if a test fails once it will continue to fail and the LED light will continue to flash. The following table gives the number of flashes and the reason these flashes appear.

LED	Reason
1 Green Flash	Normal. Presented immediately after new batteries are installed. Indicates that the CPU has started its program.
1 Green Flash	Occurs at the time of sampling for sample intervals of 1 minute or less.
5 Green Flashes	Normal. Indicates that Cyclops-7 Logger is beginning to record measurements. This indication appears in response to switching the Logger Control Switch to "Record."
5 Red Flashes	Normal. Indicates the Cyclops-7 Logger is ending recording of measurements. This indication appears in response to switching the Logger Control Switch to "Halt."
Continuously Green	Normal. Indicates the Cyclops-7 Logger is connected to a HOST computer via the USB connection.
Continuously Flashing Red	SD card write error. Try removing/reinstalling batteries. Contact PME.

AUTORANGING

The Cyclops-7 sensor has three output ranges: 1X, 10X and 100X. The best of these ranges is automatically selected by the logger based on the voltage measured of the sensor. The logger software remembers the best range and, at each sample time, first measures sensor output voltage using this range. Software then reviews this voltage to determine if the range was appropriate. In most cases the range will be appropriate, and the measurement is recorded. However sometimes software determines that a different range would yield a better measurement. In this case software selects a new "best range" and re-measures the sensor output voltage using this range. This best new range becomes the range selected at the next sample time. The best range is determined as follows:

Sensor Voltage (Gain = 1)	Best Range
0.00 to 0.04	100X
0.04 to 0.4	10X
0.4 and higher	1X

Should the first voltage measurement be unacceptably close to the sensor maximum output voltage (an over-range condition) the first voltage is re-measured using range of 1X and the best range calculated. This range becomes the best range and software proceeds as above.

CALCULATION OF ENGINEERING UNITS

Engineering units are calculated from voltage measurements of the sensor and from information gained during calibration (see Chapter 4). The result of calibration is the following information:

Name	Definition
$Vz1$	Voltage output of sensor in zero solution on range 1X
$Vz10$	Voltage output of sensor in zero solution on range 10X
$Vz100$	Voltage output of sensor in zero solution on range 100X
S	Sensitivity of sensor

$Vz1$, $Vz10$, and $Vz100$ are measured with the sensor in a solution of zero concentration. S is determined from the voltage output of the sensor using the "best range", described above, with the sensor in a reference solution of known concentration. The user must enter the concentration value of this solution, given the name C. The sensor voltage is measured in this solution and given the name Vs. The following table shows how S is determined.

Range	S
1X	$S = C / (Vs - Vz1)$
10X	$S = 10.0 * C / (Vs - Vz10)$
100X	$S = 100 * C / (Vs - Vz100)$

Note that since only one calibration concentration is measured, there is only one S determined. However, this S is used to compute engineering units from the other ranges should these be implemented by the logger during the measurement of samples.

Engineering units are computed as shown in the following table:

Range	EU
1X	$EU = S * (Vs - Vz1)$
10X	$EU = S * (Vs - Vz10) / 10.0$
100X	$EU = S * (Vs - Vz100) / 100.0$

Engineering units computed using the same range that was used to determine S will be more accurate than engineering units computed using other ranges since the sensor may not exactly implement ranges. For example, the 100X range may actually be implemented by circuitry as 100.1X but the calculations would use 100X.

CLOSING AND OPENING

Close and open Cyclops-7 Logger like you would a flashlight: open by unscrewing the white cylinder from the black end cap. Close by screwing the white cylinder on. When closing, do not tighten the white cylinder. Just screw it on until it contacts the black end cap. See Chapter 3 for more instructions.

STORAGE WHEN NOT IN USE

Remove the batteries.

JAVA

miniDOT programs depend on Java and require Java 1.7 or higher. Update Java at https://java.com/en/download/index.jsp

UPLOAD FILES TO AN ANDROID DEVICE

It is possible to transfer your measurement files from your logger to an android device. This operation has 3 prerequisites.

1. An Android device equipped with USB On-The-Go (OTG). OTG is a feature on most modern Android devices that allows them to act as a USB host. OTG was introduced with Android

version 3.1 and should be a useable feature on **most** devices. It is still possible that your device doesn't support OTG. Please test your device with a logger **prior** to attempting to upload while in the field.

2. A USB OTG cable. This is essentially an adapter with a micro USB connector on one end that connects to your Android device and a standard A type USB plug on the other. The cable supplied with the logger connects to this end.

3. A "File Explorer" app downloaded on your Android device. These types of apps assist with being able to view and move files from device to device. "ES File Explorer" is a free app available on the Google app store and is recommended for use with the logger.

If the 3 requirements are met, then connect the logger to your device. You should see the logger green connection light come on and your device display a message about "preparing USB storage". When "USB storage ready" is shown, use your "file explorer" program to move your data from the logger onto your device.

Again, it is highly recommended that you try this operation at your workstation prior to depending upon this in the field.

Currently the associated logger programs, Control, Plot, and Concatenate, are not supported by Android devices.
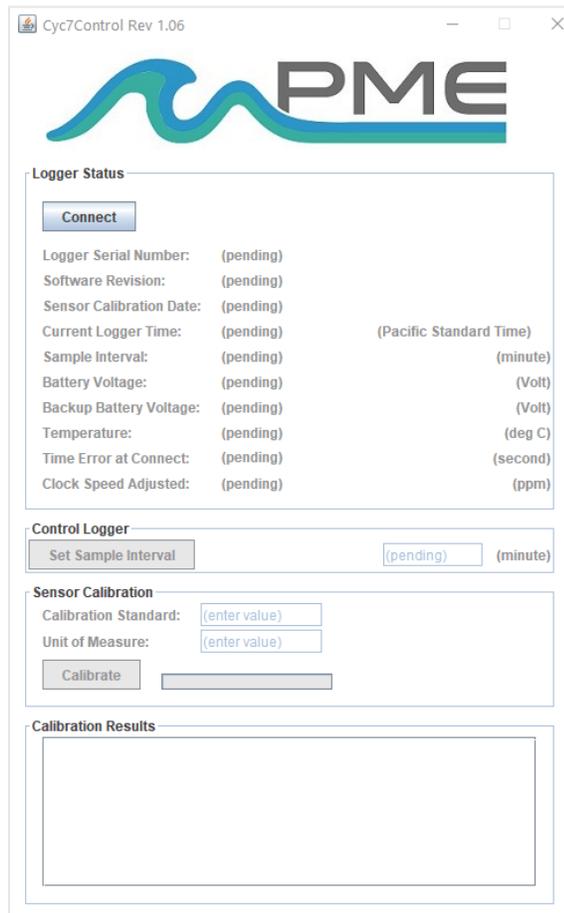
CHAPTER 2: SOFTWARE

2.1 Overview and Software Installation

The miniDOT arrives with these files:

- Cyc7Control.jar allows you to see the state of the logger as well as set the recording interval.
- Cyc7Plot.jar allows you to see plots of the recorded measurements.
- C7Concatenate.jar gathers all the daily files into one CAT.txt file.
- Manual.pdf this manual.

These files are located on the root directory of the Cyclops-7 Logger.

PME suggests you leave these programs where they are on the Logger, but you may copy them to any folder on your computer's hard drive.

Cyc7Control, Cyc7Plot, and C7Concatenate are Java language programs that require the host computer to have the Java Runtime Engine V1.7 (JRE) or later installed. This engine is commonly required for internet applications and will likely already be installed on the host computer. You can test this by running Cyc7Plot. If this program displays its graphical user interface, then the JRE is installed. If not, then the JRE can be downloaded via internet from
http://www.java.com/en/download/windows_xpi.jsp

At this time Cyclops-7 Logger software is supported on Windows operating systems but may also operate on Macintosh and perhaps Linux.

2.2 Cyc7Control

The Cyc7Control program provides these services:

- It enables time setting (based on internet timeserver clock).

- It enables sample interval setting.

- It enables calibration of the sensor.

Turner C7 sensors, are not factory calibrated. Calibration must be physically performed by the customer. Calibration consists of an experiment where the sensor is exposed to two solutions, the first having 0 concentration of the sensed material

(chl-a, rhodamine… whatever the C7 sensor senses) and a second solution having a known concentration created by the customer. Cyc7Control software records sensor output in each solution and creates a linear fit to these two points. After calibration, the Cyclops 7 Logger will measure sensor output and record it in engineering units using this linear fit.

Begin program operation by clicking on Cyc7Control.jar. Software presents the screen shown below:

The Cyclops-7 Logger must be connected to USB at this time. When correctly connected the Logger will display a constant green light.

Click the Connect button. The software will contact the logger. If the connection is successful, the button will turn green and display "Connected". The Serial Number and other parameters will be filled in from information taken from the Logger.

If the host computer is connected to the internet, the current difference between an internet time server's time and the Logger internal clock will be displayed. And, if more than a week has passed since time was last set, the Logger clock will be set, and check mark icon will appear. If the host computer is not connected to the internet no time services will occur

The current Logger sample interval will be displayed next to the Set Sample Interval button. If this interval is acceptable the interval need not be set.

To set the interval, enter a interval not less than 1 minute and not greater than 60 minutes. Click the Set Sample Interval button. Shorter and faster intervals are available. Contact PME.

Turner C7 sensors are optical devices that operate by sending colored light into the water and observing how much light returns. The field of view available to these sensors is quite important in establishing their response. PME's Cyclops 7 Logger is supplied with a sensor cover that not only protects the sensor from damage but also establishes the field of view. This cover has slots near where it covers the sensor so that exterior water can enter and be sensed.

The sensor cover must be in position when the sensor is calibrated and must be in the same position when the sensor is used.

A small amount of light can exit through the sensor cover slots, be reflected by the container holding the calibration solution, and return. Calibrate the sensor in black containers.

Exterior light such as room lighting or sunlight can enter through the slots and cause a small measurement effect. Attempt to calibrate in the same lighting as the system will experience in field use.

Be sure that there are no bubbles trapped in the cover or stuck on the sensor.

Calibration proceeds by dipping the system in one solution and then the next. Take care not to transport one solution to the next. Mix two 0 solutions and two solutions of the sensed material. Label one each as the "calibration" and one each as the "wash" When moving the sensor back and forth first dip the sensor in the wash then into the calibration. The most noticeable effect is when the 0 solution is contaminated prior to calibration. If the 0 solution is contaminated and is actually 1, and if this is not noticed and the value 0 is entered into Cyc7Control, then later in a truly 0 solution the Cyclops 7 Logger will be indicated as a concentration of –1. A negative concentration cannot exist and so the sensor is suspected of poor measurement when the problem is that it was poorly calibrated.

Cyc7Control requires that the host computer be connected to the Cyclops 7 Logger at the time the calibration is performed. The logger must be open at this time. Take care that no calibrating solutions splash onto logger circuits.

When calibration is completed, use the sensor to log measurements in each calibration solution. Do this right away using the same solutions that were used for calibration. The values 0 and the known concentration should be recorded by the logger. This gives a check on the results of calibration.

Cyclops-7 Loggers support various Turner Cyclops-7 sensors. The sensor type is shown on a small tag inside the logger.
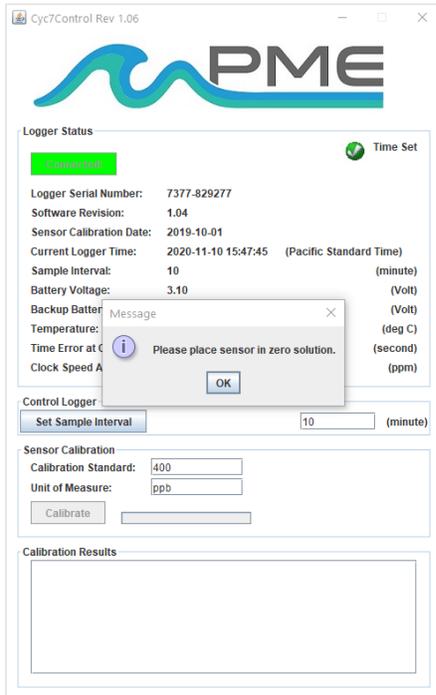
Sensors are calibrated in response to the Calibrate button, after both the Unit of Measure and the Calibration Value are entered.

Enter the unit of measure that is appropriate for the Cyclops 7 sensor mounted on the logger.

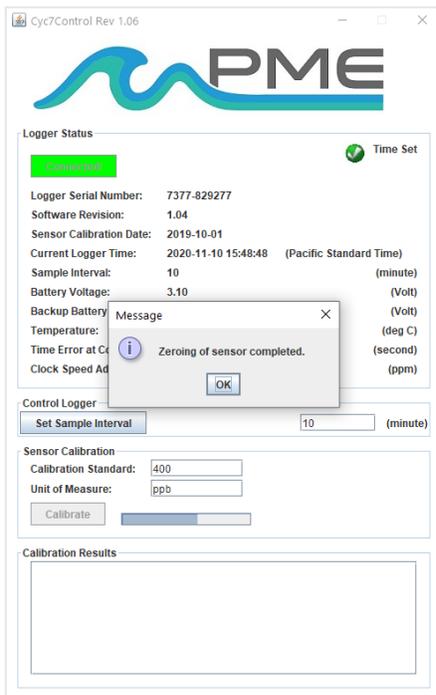Enter the calibration value for the solution.

Click on the Calibrate button. The adjacent scroll bar shows how far the program has progress through the calibration procedure.
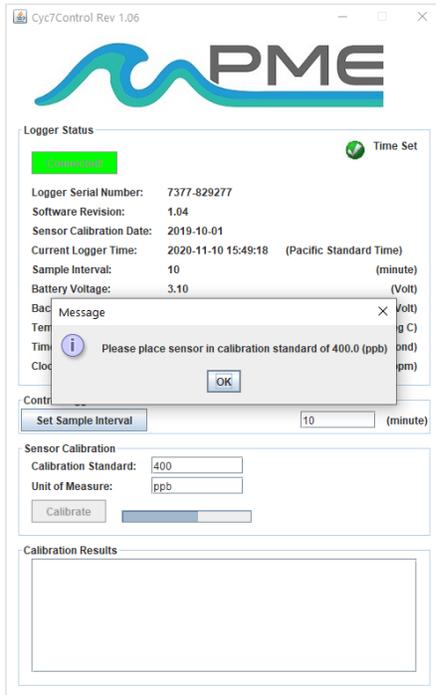
A dialog window appears instructing you to place the sensor in the zero solution. This will most likely simply be clear water contained in a bucket. Whatever the solution, the sensor after calibration will report 0 when returned to this solution. Click OK when the sensor is suitably positioned. If this solution is NOT 0 and the sensor is later placed into a solution that IS 0 the sensor will report a negative concentration! Negative concentration values can also result if the reflected light in a later solution is less.

At this time, the software reads information from the sensor, selecting all three ranges of the sensor sensitivity.

When this is completed a Zeroing of sensor completed dialog appears. Click OK.
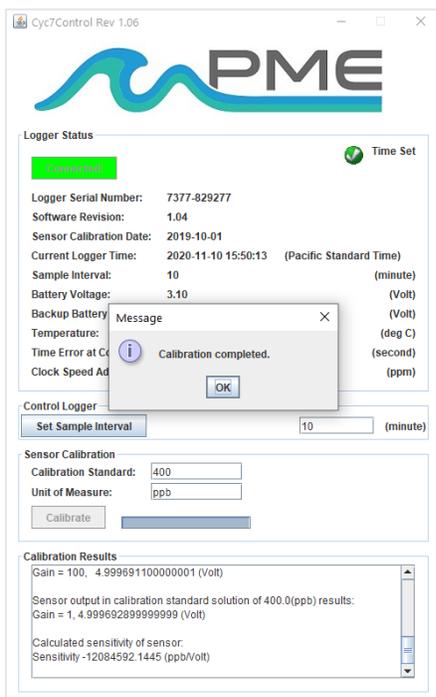
A "Please place sensor in calibration standard of <Calibration Value> (<Unit of Measure>)" dialog appears. In the screen shot above the value of 400 (ppb) is displayed. This information is taken from the Unit of Measure and Calibration Value text boxes and will be whatever is entered in the boxes.

Place the sensor in the calibration solution. Whatever the solution, the sensor after calibration will report the calibration value (400 ppb in the above example) when returned to this solution. The same considerations about solution accuracy and reflected light apply in a similar way to those a zeroing.

Click OK. At this time, the software reads information from the sensor, selecting the best sensitivity range.

When this is completed a "Calibration completed" dialog window appears along with the actual calibration results.

Notice that calibration information is displayed in the bottom window. Also, this information is automatically transmitted to the Cyclops-7 Logger. The Logger is now calibrated.

Click OK. At this time, the calibration is saved on the Cyclops-7 Logger SD card. Note that the calibration has been installed in the sensor and the sensor is calibrated no matter if the results are saved on disk or not.

A dialog window appears indicating the location where the calibration has been saved. You may later use the host computer's file copy/paste to move this file to some host computer location. You may choose to leave the file on Logger SD or delete it.

You may read the saved file later using a text file editor. The file will be like this file except that "test" will be replaced with the unit of measure selected for calibration.

==
Turner Cyclops 7 Logger Calibration
Date: Oct 17, 2014 14:54:13
S/N: 18 Battery: 3.103 (V)
Unit of Measure: test ==

Gain = 1, Sensor Output in Zero Solution, Vz1: 0.015335 (Volts)
Gain = 10, Sensor Output in Zero Solution, Vz10: 0.018888 (Volts)
Gain = 100, Sensor Output in Zero Solution, Vz100: 0.066867 (Volts)

Gain = 1, Sensor Output in 100.0(test) Solution: 1.22355 (Volts)
Gain = 1 Sensor Sensitivity (Measured at Gain = 1): 82.76672612076494 (test/Volt)

A note about judging your calibration result: The table below presents typical values that result from calibration.

Sensor	Solution	Vz1 (Volt)	Vz10 (Volt)	Vz100 (Volt)	Sensitivity (Unit)	Unit
Rhodamine	(1)	0 to 0.035	0 to 0.075	5 to 0.150	200	ppb/Volt
Phycocanin	(2)	0 to 0.035	0 to 0.075	5 to 0.150	8000	ppb/Volt
PTSA	(3)	0 to 0.035	0 to 0.200	0 to 0.500	130	ppb/Volt
Optical Brighteners	(3)	0 to 0.035	0 to 0.200	0 to 0.500	3000	ppb/Volt
CDOM	(3)	0 to 0.035	0 to 0.200	0 to 0.500	1000	ppb/Volt
Crude Oil	(3)	0 to 0.035	0 to 0.200	0 to 0.500	540	ppb/Volt
Turbidity	(4)	0 to 0.035	0 to 0.075	0.005 to 0.150	600	NTU/Volt
Fluorescein	(5)	0 to 0.035	0 to 0.075	0.005 to 0.150	100	ppb/Volt
Phycoerythrin	(6)	0 to 0.035	0 to 0.075	0 to 0.500	150	ppb/Volt
in vivo Chlorophyll	(7)	0 to 0.035	0 to 0.075	0.005 to 0.200	100	ug/l

- Rhodamine dye diluted in deionized water.
- Specific species pigment diluted in deionized water
- PTSA (1, 3, 6, 8 - Pyrenetetrasulfonic Acid Tetrasodium Salt) calibration standard
- Amco Clear Turbidity Standard Solutions (5) Fluorescein dye diluted in artificial sea water.
- Phycoerythrin pigment diluted in Deionized water
- Algal monoculture consisting of the species Skeletonena costatum.

Sensor calibrations should always show Vz1..Vz100 in the ranges given. The sensitivity can vary but variations larger than +/- 20% should be suspect.

Also note that sensors can only produce as much as 5 Volts at their lowest sensitivity. Therefore, your reference solutions have a maximum concentration that can be sensed. For example, Rhodamine typical sensitivity is 200 ppb/Volt so only a maximum of 1000 ppb can be sensed. The "Sensor Output in xxx Solution" will always be less than 5.0 Volts since this is all the sensor can produce but should be less than 4.0 Volts.

A note about Turner solid state secondary standards: These standards are not supplied with any calibration value, so they are not at first useful for calibration. However, once the sensor is calibrated the solid-state secondary standard can be placed onto the sensor and adjusted so that the sensed value is some arbitrary value.

Please refer to Turner's documentation concerning the Solid Secondary Standard that is supplied with the standard or via the internet:

http://www.turnerdesigns.com/t2/doc/instructions/998-6800.pdf

Install the standard as described. The logger's sensor guard must be unscrewed and removed for this procedure.

Operationally, adjustment of a standard is not well implemented in the logger software. Step 2 of the Use of the Solid Secondary Standard for in vivo Chlorophyll Applications on page 1 of this document assumes that the sensor output can be viewed in real time. However, this output can only be logged by the Cyclops-7 Logger. A short recording of the measurement must be made, and then the record reviewed, to determine the sensed value. The process must be repeated by trials to adjust the standard as described in the document.

A note on chlorophyll calibration: Please review the Turner Designs document titled "In Vivo Chlorophyll: Concepts & Concerns". PME sometimes provides this document together with this Manual or it can be found at Turner's Application Notes.

2.3 Cyc7Plot

The Cyc7Plot program provides the service of plotting Cyclops-7 Logger files.Begin program operation by clicking on C7Plot.jar. Software presents the screen shown below.
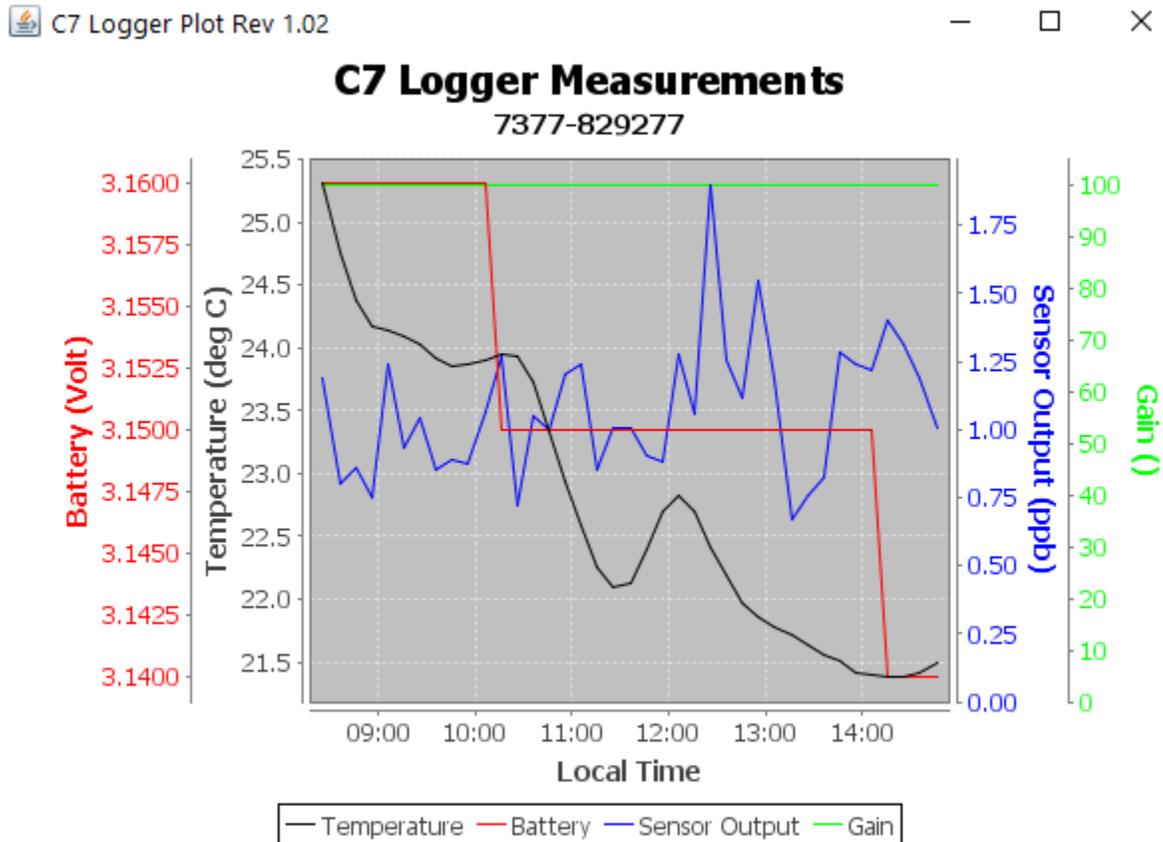

C7Plot plots the files recorded by the Cyclops-7 Logger. The software reads all Logger files in a folder, except the CAT.txt file. Notice that the software has automatically suggested the Cyclops-7 Logger SD card as the Data Folder. You may accept this or click Select DATA Folder to find some other source for the plot.

DATA folders MUST NOT contain any other files besides files written by the Cyclops7 Logger. This folder can be on the SD card from the Cyclops-7 or it can be from a copy of this on your computer's hard drive.

A few thousand measurements can be plotted directly from Cyclops-7 Logger SD. However, it is best to copy large measurement sets to the host computer and select them there since file access to the Logger is slow.

Press 'Plot' to begin measurement processing. The software reads all Cyclops-7 Logger data files in the Data presents a plot of the measurements like the plot shown below.

You may zoom this plot by drawing a square from upper left to lower right (click and hold left mouse button) that defines the zoom region. To zoom completely out, attempt to draw a square from lower right to upper left. The mouse will scroll the image if the CTRL key is held down. Right click on the plot for options such as copy and print.

The software may be run multiple times at the same time (select Data Folder, press Process, select new Data Folder, press Process...). In this case it produces multiple plots. Presently the plots are presented exactly on top of each other and so when a new plot appears it is not obvious that the old plot is still there. It is. Just move the new plot to see it. Closing any plot closes all.

End C7Plot by closing any window.

The software can be re-run at any time. If an already processed DATA Folder is selected the software, simply reads the measurement files again.

SPECIAL NOTE: plotting of sample sets of more than 200K samples may consume all memory available to the host computer's Java. C7Plot will present a partial plot and freeze in this case. A simple solution is to separate the files into multiple folders and plot each folder individually.

2.4 Cyc7Concatenate

The Cyc7Concatenate program provides these services:

- It gathers all Cyclops-7 Logger files in the DATA folder in time sequence.

- It translates the Logger time stamp into two additional formats.

- It writes all times and measurements into a single CAT.txt file in the DATA Folder.

Begin program operation by clicking on Cyc7Concatenate.jar. Software presents the screen shown below.

Cyc7Concatenate concatenates the files recorded by the Cyclops-7 Logger. The software reads all Logger files in a folder, except the CAT.txt file. Software translates Logger time stamps into two additional formats and saves the result in a CAT.txt file in the DATA Folder.

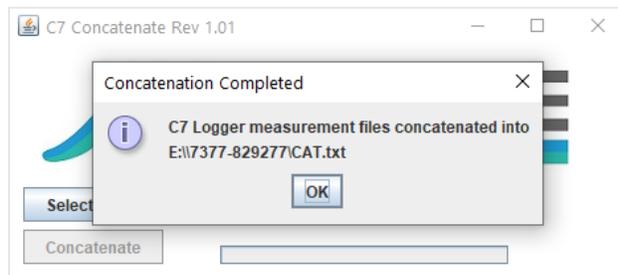Notice that the software has automatically suggested the Cyclops-7 Logger SD card as the Data Folder. You may accept this or click Select DATA Folder to find some other source for the plot.

DATA folders MUST NOT contain any other files besides files written by the Cyclops7 Logger. This folder can be on the SD card from the Cyclops-7 or it can be from a copy of this on your computer's hard drive.

A few thousand measurements can be concatenated directly from Cyclops-7 Logger SD. However, it is best to copy large measurement sets to the host computer and select them there since file access to the Logger is slow.

Press 'Concatenate' to begin measurement processing. The software reads all Cyclops-7 Logger data files in the DATA Folder. These are written to the same folder. Software presents a dialog window when the process is completed.

Click OK. The Cyc7Concatenate software can be re-run at any time.

End Cyc7Concatenate operation by closing the window.

The CAT.txt file will resemble the following:

```
C7 Logger Concatenated Data File
Logger:          7377-191770
Concatenation Date: 2015Feb25 08:17:38 PST


        Unix Timestamp,        UTC_Date_&_Time,       Pacific Standard Time,    Battery,   Temperature,     Sensor,
          (Second),              (none),                   (none),              (Volt),      (deg C),      ( Volt),
        1422635520,        2015-01-30 16:32:00,        2015-01-30 08:32:00,     2.570000,    17.742000,     0.000726,
        1422639120,        2015-01-30 17:32:00,        2015-01-30 09:32:00,     2.650000,    17.937000,     0.000670,
        1422642720,        2015-01-30 18:32:00,        2015-01-30 10:32:00,     2.660000,    18.309000,     0.000663,
        1422646320,        2015-01-30 19:32:00,        2015-01-30 11:32:00,     2.670000,    18.722000,     0.000823,
        1422649920,        2015-01-30 20:32:00,        2015-01-30 12:32:00,     2.680000,    19.051000,     0.000703,
        1422653520,        2015-01-30 21:32:00,        2015-01-30 13:32:00,     2.680000,    19.278000,     0.000691,
        1422657120,        2015-01-30 22:32:00,        2015-01-30 14:32:00,     2.690000,    19.623000,     0.000805,
        1422660720,        2015-01-30 23:32:00,        2015-01-30 15:32:00,     2.690000,    19.918000,     0.000672,
        1422664320,        2015-01-31 00:32:00,        2015-01-30 16:32:00,     2.690000,    19.825000,     0.000706,
        1422667920,        2015-01-31 01:32:00,        2015-01-30 17:32:00,     2.640000,    19.741000,     0.000674,
        1422671520,        2015-01-31 02:32:00,        2015-01-30 18:32:00,     2.660000,    19.127000,     0.000714,
        1422675120,        2015-01-31 03:32:00,        2015-01-30 19:32:00,     2.660000,    18.469000,     0.000688,
        1422678720,        2015-01-31 04:32:00,        2015-01-30 20:32:00,     2.670000,    17.954000,     0.000699,
```

CHAPTER 3: CYCLOPS-7 LOGGER

3.1 Overview

All the Cyclops-7 Logger measurements pass from the sensors onto the SD card it contains. Files are transferred to a host computer via USB connection where the Cyclops-7 Logger appears as a "thumb drive". Measurements may be plotted by Cyc7Plot and files concatenated by Cyc7Concatenate. The Cyclops-7 Logger itself is controlled and calibrated by Cyc7Control. Customers are required to open the logger each time measurements are transferred to the host computer. This chapter describes the logger internal features.

3.2 Opening and Closing the Logger

The logger circuitry is contained in a waterproof housing that must be opened. The housing is opened by unscrewing the white pressure housing from the black end cap. Turn the pressure housing counter clockwise relative to black end cap. Close by reversing this procedure after being sure that the o-ring is free from debris. Lube o-ring occasionally with grease intended for buna-n o-ring material.

The logger is much more difficult to open than to close. Screw the white logger housing onto the black cap until the housing touches the cap. No further tightening is necessary.

Please attempt to handle the Cyc7Logger only by the aluminum chassis, without touching the circuit card.

When closing the Cyclops-7 Logger inspect the o-ring and interior of the white cylinder for debris, lube the o-ring, and screw the white cylinder onto the black end cap until the cylinder just touches the end cap. Do not Tighten! The Cyclops-7 Logger tends to get a little tighter during deployment.

If you cannot open the Cyclops-7 Logger by yourself, find another person with strong hands. This person should grip the black end cap while you turn the white cylinder.

3.3 Electrical Connections and Controls

Removal of the cover reveals the logger connections and controls, shown below.

The **LED Light** is a LED that can display either red or green light. This is used to indicate different features described in Chapter 1 in this manual.

The **Logger Control Switch** controls the logger mode:

- **RECORD:** When the switch is in this position the logger is recording measurements.
- **HALT:** When the switch is in this position the logger is not recording and is sleeping at low power.

The **USB Connection allows** communication between the logger and an external host computer. When connected, the logger is in halt mode regardless of the Logger Control Switch position. When disconnected the logger mode is controlled by the switch position. The switch position may be changed while the USB is connected.

The **Main Batteries** (2 X "C" at right of picture above) provide main power to the Cyclops-7 Logger. Note the positive (+) terminal.

Caution: Improper replacement of the batteries will damage the Cyclops-7 Logger.

3.4 Battery Replacement

Carefully remove both "C" cells, noting the direction of the (+) terminals. Take care not to break the glue connection between the holder and the aluminum chassis. These both are oriented towards the Logger circuit. Insert new 'C' cells into the paper tube and re-install the pair into the battery holder. When replacing batteries use only fresh batteries. Do not mix battery types. If one battery differs in type or charge level from the other and the Cyclops-7 Logger runs them to full discharge, then one battery may leak.

If you install the batteries backwards, then you should plan to purchase a new Cyclops-7 Logger circuit board.

3.5 Interchangeable Sensor Installation

PME provides two types of Cyclops-7 loggers. One type has the sensor permanently mounted by PME. This section describes the other type where the sensor is plugged to the logger. The other features described throughout this document are the same for both types of loggers.

Arrange the parts as shown in the picture below

The small circular black clip shown to the right of the C7 sensor will be found installed on the logger connector. This can be removed by unscrewing it from the connector, and then gently prying open the 'C' clip center piece.

Screw one side of the clip fully on to the sensor. Screw the opposite side fully onto the connector as shown in the picture below.

Be sure both are fully screwed on. If either is not, the clip will hold the sensor in a position where it may not make full contact with the connector.

Plug the senor fully into the connector as shown in the picture below.

The clip faces will mate. Note that if the clip is not fully screwed onto the connector it will still appear as shown in the picture above, but the sensor may not be making complete reliable contact with the logger.

Snap the remaining clip part onto the clip to secure the sensor to clip connection.

Slide the sensor support (middle-right in first picture) over the sensor. Note this part has an internal o-ring that comes against the sensor. This is not a water-proof seal. Its purpose is to firmly secure the sensor within the support. Next screw the sensor guard (middle left in first picture) onto the sensor support. The completed assembly is shown in the picture below.

When exchanging the sensor, reverse the process steps given above.

The sensor connector is itself threaded into the logger end cap. This connector is tightened, but since the logger end cap is plastic there is a limit to how tightened this connector can be made. If the connector unscrews water can enter the logger and cause permanent damage. Be observant when installing sensors. When installed, the sensor should not be able to be rotated. Take care not to unscrew the sensor and watch the sensor when unscrewing the sensor support since the o-ring will apply a slight loosing rotation to the sensor. Should the sensor/connector become loose discontinue use of the logger and contact PME.

3.6 Notes

This section collects general notes concerning the instrument.

Do not use harsh solvents on any of the logger plastic parts. Do not use acetone on the sensor guard. This part is constructed of ABS plastic and will dissolve if exposed to acetone.

Enjoy your new Cyclops-7 Logger!