Optical Phytoplankton Discriminator User Guide

Low Pressure Unit

Version 1.3   May 4, 2009

This user's guide is an evolving document. Please contact us with any questions.

Mote Marine Laboratory
1600 Ken Thompson Parkway
Sarasota, Florida 34236
(941)-388-4441 ext. 275

Section 1: General Information

1.1 General Description

The Optical Phytoplankton Discriminator (OPD) is an electronic instrument that measures for the presence of algae organisms from their optical absorbance characteristics; this is accomplished by pumping a water sample through a Liquid Waveguide Capillary Cell (LWCC), illuminating it with a light source, and measuring the resulting light absorption spectra. A single measurement cycle takes up to eight minutes. The interval between cycles is programmable from 30 minutes to several hours.

After each cycle a data report is logged internally or is sent to a host computer or any telemetry system that supports serial data communications.

There are currently two models of the OPD instrument. A low-pressure model that is designed for shallow deployments and a high-pressured model designed for AUV, vertical profiler or towed deployments (100 meters maximum depth).

The OPD is designed, once started, to operate autonomously or under the step-by-step control of a host. There are a number of user settable parameters that are used by the program to sample the water, acquire spectral data, analyze the data and calculate a phytoplankton similarity index, and to log and report the results. This manual will guide the user for basic functions of the instrument.

1.2 Specifications

Mechanical:

Weight (in air)	13 kg
Diameter	21 cm
Length	31 cm

Electrical:

Voltage	12v DC
Current	6400 mA average while sampling
Current	.01 mA while in sleep mode between cycles
	10 mA

Data:

Sample Period	Consecutively (hosted) or 30 minutes + (nohost mode)
Sample Cycle Duration	5-8 minutes
Data Output	RS-232
Baud Rate	9600 to 115200, programmable
Data format	ASCII text

1.3 Contents of Shipping Case

Pelican Case

Sample port

Zincs for the end caps

BreveBuster unit

Male bulkhead connector for download cable

Download cable: DB-9 connector at one end, 5 pin underwater connector on the other and switchbox connector.

Power supply

Switch box

DB9 Connector for Serial comm. Port

Female end of download
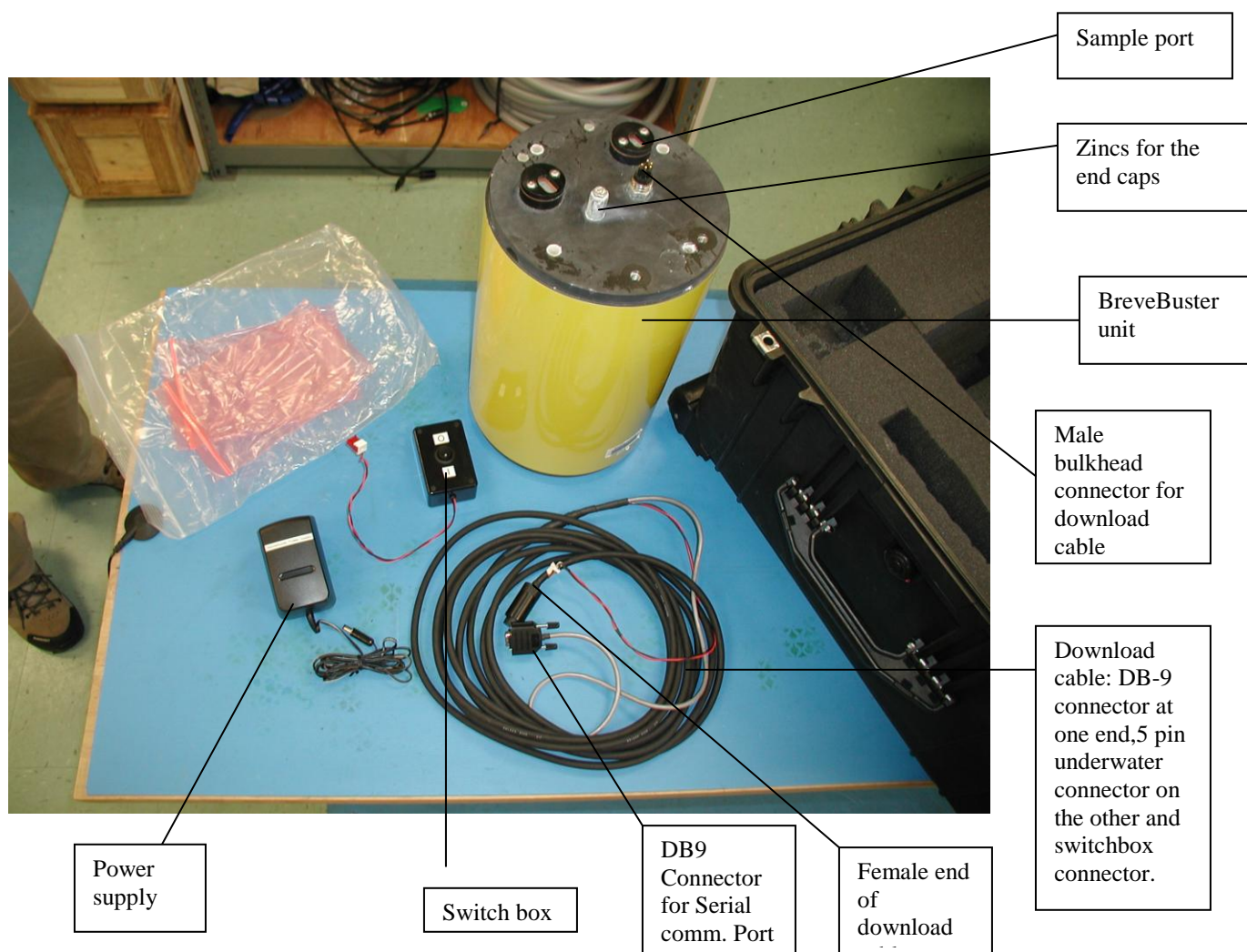
Also included in shipping case is one "dummy plug" and a set of hull separators.

Additional available accessories:

    2 sample port tube extensions
    Liquid Waveguide Cleaning Kit
    CDOM reference
    Extra tubing package w/O-rings
    5ml. Luer-Lok Syringe
    50ml Luer-Lok Syringe
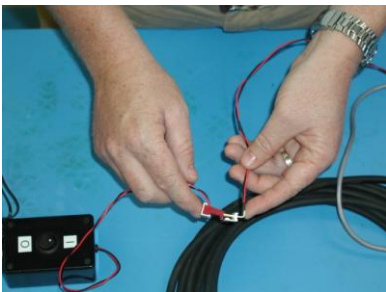   .22 μm Luer-Lok in-line filter

Section 2: Operations

2.1 Establishing Connections

1.   Plug in power supply to power source.

2.   Connect switchbox to power supply and to download cable.
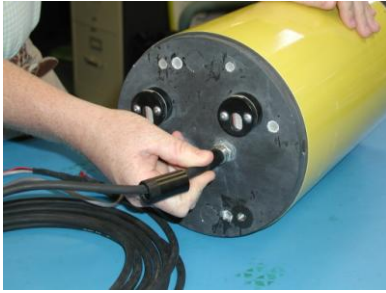

Do not turn switchbox on yet.
.

3.   Connect the DB-9 connector on the download cable to the user's computer serial comm port.

4.   Connect female end of the download cable (MCIL-5-FS) to the male bulkhead connector on the unit (MCBH-5-MP).

Once the system is all connected, it will look like this:
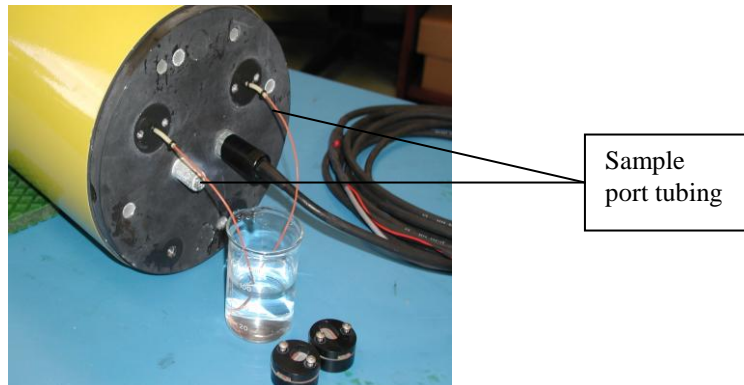
2.2 Water Sample

If the water sample is a in a big container (bucket), the unit may be inserted in it always having the sampling ports faced down and submerged in the sample. Make sure the unit does not pinch the download cable. A way to avoid this is to place an object at the bottom of the bucket to elevate the unit and free the cable.
If the water sample is in a small container (beaker, or jar) the sample port tube extensions will be placed on the unit.

1. Using a 3/32 Allen wrench, remove both sample port covers.

2. Place extensions over sample port tube and insert in sample beaker.

Sample port tubing

3. Once water sample is ready and parameters are entered, the unit is ready to run a cycle.
4. If the user decides to run a CDOM Reference (*see OPD commands, page 13)* with each cycle, do not use the sample water to collect the CDOM Reference waste
5. water. Use a separate beaker for the waste until the CDOM Reference cycle is done. Then insert your ports in your water sample and proceed. Do this in accordance with however many cycles are desired.

2.3 Communications

See Appendix A (page 25) to install OPD Setup and control on computer.

1. Open OPD Setup and Control Program on the computer. Setup page appears on screen.
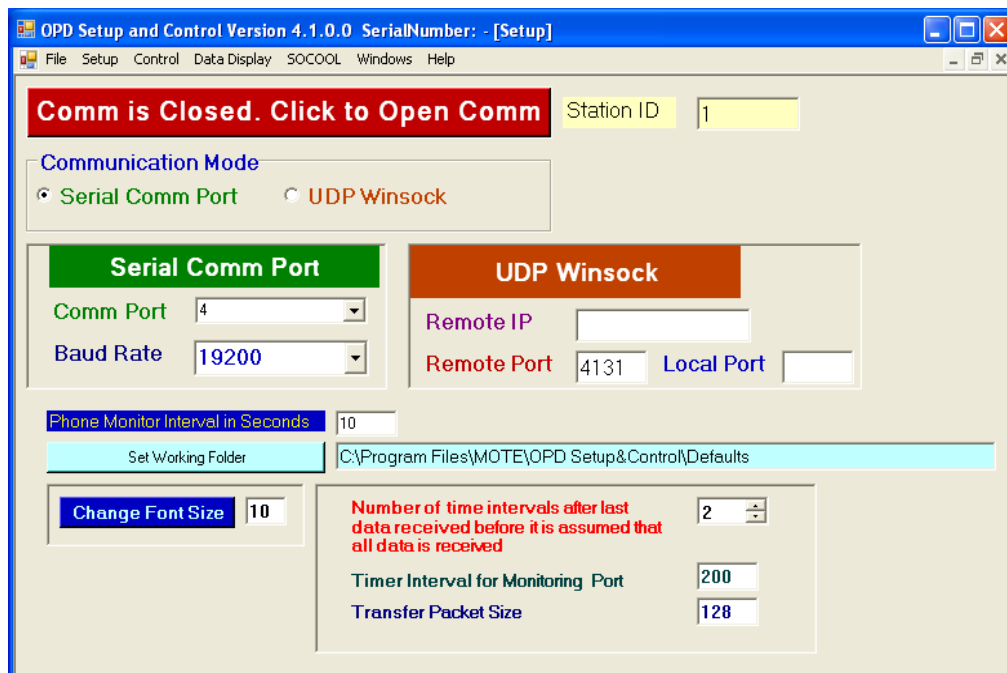
2.   Choose the appropriate **Serial Comm Port** corresponding to the port. If only one comm. port is available, then select comm. port 1.

3. Set the Baud Rate to 19200.This number is the standard for the Optical Phytoplankton Detector.

4. Click on **Comm is Closed. Click to Open Comm**. The box will turn blue once open. **Comm is Open. Click to Close Comm**

5. In the tool bar, click Control. If communication is established, the cursor on the main part of the screen will be blinking.

> *Note: If a pop up screen appears saying No remote Communications have been established, go back to setup page and check* **Serial Comm Port** *settings.*

6. Once communication is established, turn power on to the OPD through the switchbox.

Below is the main header and C: prompt in PicoDOS mode that appears in the text dialog center portion of the Control screen when the Persistor processor starts up:

```
--------------------------------------------------------------------
 Persistor CF2I5   SN 01944   PicoDOS V4.02r1     PBM V4.00
 (C) 1998-2005 Persistor Instruments Inc. - www.persistor.com
--------------------------------------------------------------------
```

C:\>
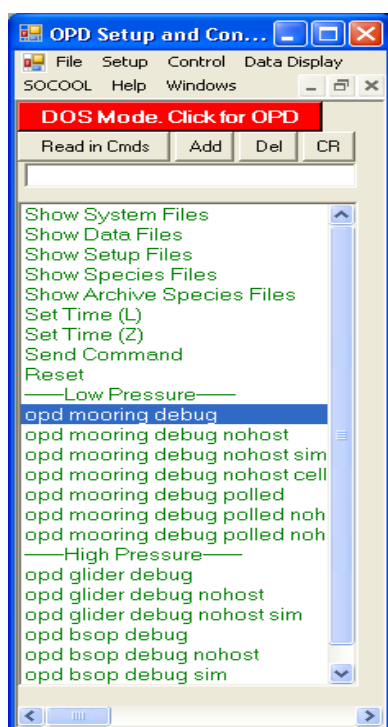
In **DOS Mode**, the OPD program needs to be. *See Mode descriptions page 12.*
For the standard hosted low pressure version, select opd mooring debug from the Low Pressure left hand menu.

Once the instrument type is specified a message like this will appear on the screen:

> c:\>opd mooring debug
>
> Voltage after Init() is:
> 12.990506 volts.
>
> 01/14/08 13:13:29
>
> Ready

The OPD sensor is now ready to run a cycle.

2.4 Running a cycle

1. Select the appropriate sensor mode if it hasn't been done.

2. Click on **DOS Mode.Click for OPD**. When selected the box turns blue.
   OPD Mode. Click for DOS

3. Now, the OPD mode command list is populated on the left side of the screen.

4. Under ---Reports--- check the Sampling Setup and Status Report. These options are good to reference before initiating a cycle. They will inform the user of how the sensor is setup.

5. To change any of the parameters seen in the Sampling Setup or Status Report, under -----Setup----- in the left side of the screen, select the parameters to be changed. These values are user specific.

> *See page 14 for OPD Setup Command descriptions.*
> *See Appendix B: Setup default values Page 25.*

A pop up for each parameter selected will appear on the screen to enter the values desired.

Example: cycles to do
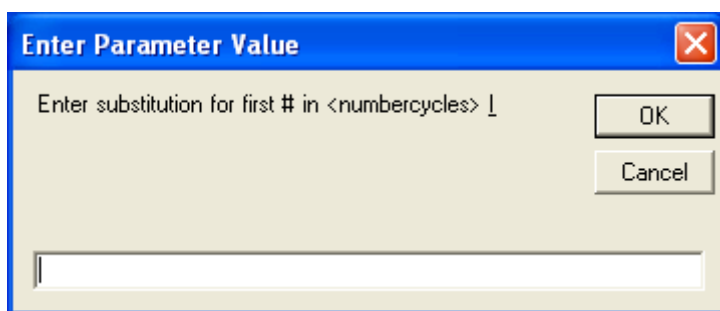
Enter a value and click ok.

Once the configuration is checked the OPD is ready to run a cycle.

6. Click on Start. This will start the sampling! Make sure the sample is ready!
7. As the cycle(s) are in progress, the data displayed on the screen will inform the user of the progress of the run.

  As a cycle is running, there will be a continuous stream of data on the screen.
  This is an example:

```
SN 17 cycle #1 of #0 cycles with cycletime 0
11/28/07 20:52:52
Voltage before starting cycle 1 is: 12.546347 volts.
```

First part of message informs of instrument Serial number, cycle number that will run and total number of cycles, cycle time, date and time and battery voltage instrument currently has.

```
Adjust integration time.
93 ms:
```

Length of time spectrometer collects pixels to make the peak value 54000-59000.

```
Pixel 1095 = 59103 , Pixel 703 [440nm] = 37196
```

```
84 ms:
Pixel 1095 = 54417 , Pixel 703 [440nm] = 34266


Valid integration time = 84 ms

Dark:
Pixel 399 = 2455 , Pixel 703 [440nm] = 2400
```

Cycle ran without light. Pixel value will be low compared to rest of cycles

```
CDOM:
Pixel 1095 = 54265 , Pixel 703 [440nm] = 34337
```

Cycle of filtered CDOM.
When running CDOM Ref cycle, similar message will appear for CDOM Ref cycle.

```
Discriminate:
Pixel 1094 = 48687 , Pixel 703 [440nm] = 30097
Pixel 1095 = 51542 , Pixel 703 [440nm] = 32185
```

Double discriminate of sample water.

```
***17, 12.547, 28.541, 0, 84, 225, 11/28/07, 20:53:17, 2720.032/-8234.744,
0.000, 0.000, 0, 0.36, KBAVG
```

Final message where similarity index is reflected. (See page 17)

8. When ready to stop or run another operation, select stop from the sampling listbox. (The stop command will not stop a cycle immediately if you are running a cycle. A stopped message will appear).
9. Select exit from the toolbar and wait for a message Log file closed followed by the command prompt. Power can be turned off from the switch box.
10. To exit the program, select Close from File in the menu.

2.5 Mode Description

There are two modes with-in the program OPD setup and control: OPD and DOS.

DOS mode

Is a command prompt mode where the kind of OPD program being used needs to be selected before using OPD mode.
There are currently two instrument types: Glider and Mooring.

Mooring units are low pressure units.
Glider units are a high pressure units.

This manual describes only the **low pressure unit operation. For high pressure units, please contact our technical center.*

Within the low pressure mooring unit, there are several options:

opd mooring debug   :this is the hosted mode
opd mooring debug polled   :hosted and polled
opd mooring debug nohost   :non hosted
opd mooring debug nohost sim   :nohost and sim
opd mooring debug nohost polled   :hosted and polled

* Any combination of these commands can be used as long as opd mooring is used first

If not specified the instrument used this error message will appear:

C:\>(opd debug) example of missing instrument type (Mooring, Glider)

Version: 4.1r1 PRODUCTION 06 December 2007
No instrument or VER specified...exiting to PicoDos

See Glossary (page 26) for more definitions.

OPD
After the instrument is operating under an OPD mode, commands can be sent to be executed
by the OPD processor by directly choosing commands from the OPD command menu.
These commands are subject to the type of instrument selected.

2.6 OPD Commands

Important note*: the OPD menu commands executed immediately once clicked on.*
To avoid problems, do not click on any command unless fully certain of content. There is no
confirmation checking. Once clicked, it will do what it is told.

In OPD mode, the following commands appear in the left menu:

| Command	Definition
Sampling	
Start	Starts a run based on setup parameters.
Stop	Stops the currently running cycle. The screen will read Stop requested. *this will not happen immediately
	Will also bring the unit out of sleep mode.
Exit	Closes Log files and shuts down OPD. Returns to PicoDOS.
	The screen will say Log file closed. Will also bring the unit out of sleep mode.
Status	Reports the status message after a cycle in polled mode.
Setup	
cycles to do	This sets the number of sample cycles per run. . A value of "0" means an infinite number of cycles. The value of "1" means one cycle will run, the value of "2" means two cycles will run etc…
cycle time	Number of minutes in between cycles. Minimum is 30
Set time to local	Sets time to local time
Set time to GMT	Sets time to Greenwich Mean Time
Disc repeat rate	Number of times the discriminate is repeated in a cycle. If 1 is entered then it will do a total of 2 discriminates.
Messages on	Turns Debug output on
Messages off	Turns Debug output off
CDOM ref interval	Numerates the cycles at which a CDOM reference measurement is taken. I.e. x=9 would be cycle # 1, 9, 18, 27, etc…
CDOMref & CDOM flush time	Number in seconds that the CDOM reference pump and Sample pump will run.
CDOM ref supply ml	Amount of CDOM ref in ml left in the CDOM bag.
CDOM reference on	Turns CDOM ref on or True
CDOM reference off	Turns CDOM ref off or False.
Reports	
Sampling Setup	Reports the sample *Setup*s' current configuration settings set by the user. By selecting Sampling Setup the user can view the current parameters set in the unit. This allows the user to decide if the parameters are set to the correct values or need modification.
Sensors Report	Reports serial number of unit, version number, bypass pressure value, battery voltage, sample pump position, depth, valve position, CDOM reference and time.

2.7 LP OPD Commands

Command	Definition
Shutter Open	Opens light shutter
Shutter Closed	Shuts light shutter
Lights on	Turns D2 light on
Deuterium on	Turns Deuterium light on
Tungsten on	Turns Tungsten light on
Lights off	Turns light off
Select Filter	Selects Filter channel for water sample
Select Bypass	Selects Bypass channel for water sample
Select Closed	Closes off water flow
Reference Pump On	Turns CDOM reference pump on
Reference Pump Off	Turns CDOM reference pump off
Sample Pump On	Turns sample pump on
Sample Pump Off	Turns sample pump off
Set Valve A	Changes Valve to A port
Set Valve B	Changes Valve to B port
Valve Toggle	Instructs valve to switch to other port
Status Report	Reports current message even if you have done a cycle
LWCC Flush	Makes reference pump run forward and then reverse multiple times This is used mainly to run cleaning solutions through system.

2.8 Downloading Data Files

1. Go to Control in the Tool bar. Make sure you are in PICO DOS. (if not there, exit to it).
2. On the right side of screen, listed with pink background under Remote are the files found in the sensor unit, and listed in blue under Local are files on the computer under the path name above labeled "Choose". The program displays a default page to save the data. C:\Program Files\Mote Marine Laboratory\Defaults\
3. Click on c:\results\. All the data files will be displayed.
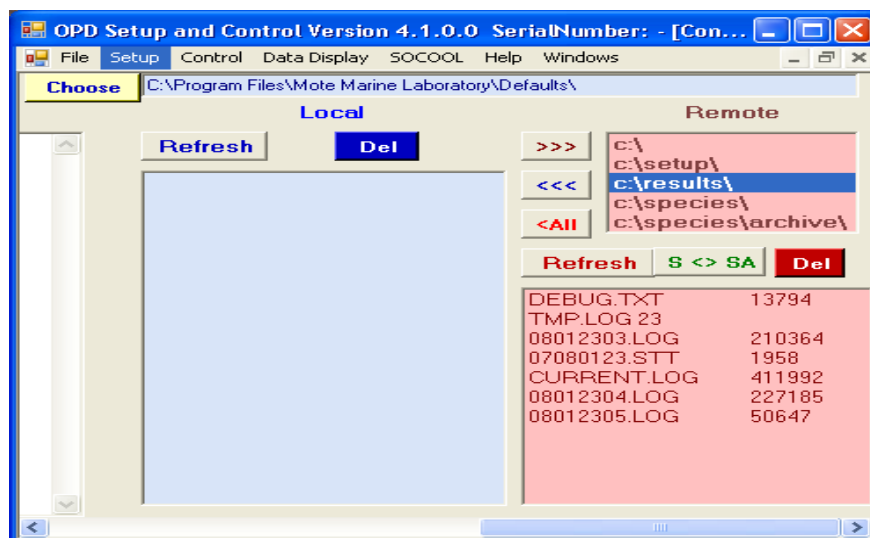
4. Click on the file(s) desired to be transported to the Local CPU.
   Use the arrows (<<<) to move the files or if all the files are wanted click on the All button (once clicked on it starts immediately to download the files).
   It may take a while to download depending on the amount of recorded data.
5. Once the data is downloaded an EOT (End of Transmission) message will appear on the screen. The downloaded files will appear under the Local box, as well as the Remote box. It is good to compare file sizes to make sure you had a good file transmission.
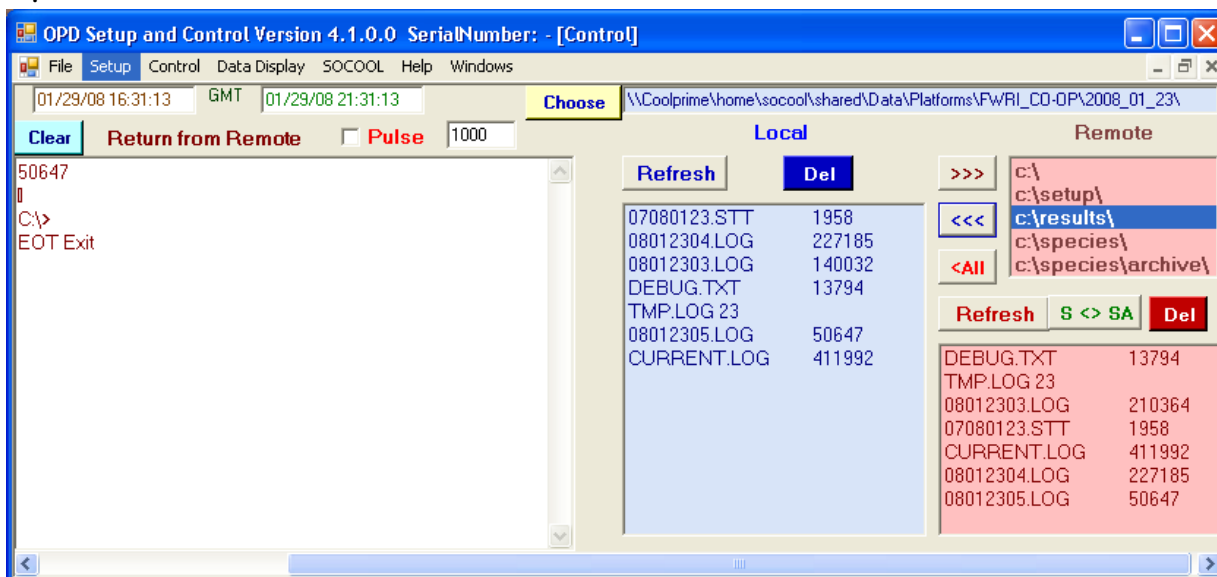
6.   Files are now successfully retrieved from the Optical Phytoplankton Detector and saved on the computer.

2.9 Result Folder Files

xxxxxxxx.STT

Named automatically as SNyymmdd.STT where SN is the units serial number, yy is the year,mm is the month and dd is the day.

It is a file that saves all the status messages of a sampling event.

Example of a status message:

```
***19, 12.932, 20.355, 0, 30, 497, 12/20/07, 11:00:42, 2720.032/-08234.744,
0.000, 0.000, 0, 0.39, KBAVG
```

The significance of each part of the status message is given in parenthesis in the following example:

```
***19 (serial number), 12.932(voltage), 20.355(ByPass Pressure psi), 0(Error
Status),  30(integration  Time),  497(CDOMRef  in  ml.),  12/20/07(Date),
11:00:42(Sample   time),   2720.032/-08234.744(lat   ddmm.mm/longddmm.mm),
0.000(Absorbance   slope),   0.000(Absorbance   intersept),   0(Spare),
0.39(Similarity Index), KBAVG(species model)
```

xxxxxxxx.LOG

Named as yymmddss.LOG where yy is the year, mm is the month, dd is the day and ss is the second.

A log file is not an ASCII text file. It cannot be viewed with NOTEPAD or WORDPAD. A program is needed to decipher the contents of the log file. The file contains a mixture of character strings and spectrometer readings.

DEBUG.TXT

It is a file that gives all data of a cycle or cycles run.

File cannot be opened with NOTEPAD, it must be opened with WORDPAD.

Example of data displayed in a .TXT file:

```
SN 17 cycle #1 of #0 cycles with cycletime 0
11/28/07 20:52:52
Voltage before starting cycle 1 is: 12.546347 volts.

Adjust integration time.
93 ms:
Pixel 1095 = 59103 , Pixel 703 [440nm] = 37196
84 ms:
Pixel 1095 = 54417 , Pixel 703 [440nm] = 34266
Valid integration time = 84 ms
Dark:
Pixel 399 = 2455 , Pixel 703 [440nm] = 2400
CDOM:
Pixel 1095 = 54265 , Pixel 703 [440nm] = 34337
Discriminate:
Pixel 1094 = 48687 , Pixel 703 [440nm] = 30097
Pixel 1095 = 51542 , Pixel 703 [440nm] = 32185
***17, 12.547, 28.541, 0, 84, 225, 11/28/07, 20:53:17, 2720.032/-8234.744,
0.000, 0.000, 0, 0.36, KBAVG
```
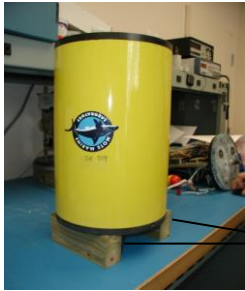
current.log & tmp.log

They are active back up copies of the primary log file and are written to be copied continuously during normal cycles.

Section 3: Maintenance

3.1 Removing Hull

1.   Place the Optical Phtyoplankton Detector with the sampling ports facing down and rest it on a support (stands) to avoid damage.

Wood stands

This side up

2.   Remove the two MS plugs that are aligned with the indents on the metal plate. They will be located opposite to one another on the plate. Use a 3/16 allen wrench.

Indent on plate

3.   Underneath each one there is a ¼ - 20 socket head cap screw with a fiber washer. Remove as well using a 3/16 allen wrench.

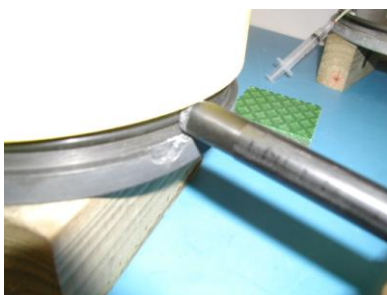The other two MS plugs do not need to be removed.

4.   Find the indents on the top plate. Use the hull separators by twisting back and forth on both sides.

5.   Once loose, remove the top plate.

6.   Repeat step 5 on the bottom plate. Use the hull separator to work your way around the plate until the hull is loose.

7.   Remove hull once loose.

3.2 Replenishing CDOM Reference Fluid

To fill up the CDOM reference bag, use a syringe that will fit the PharMed® tubing. It should be filled with .22um filtered water of the body of water you will be sampling in.

1.   Place the CDOM Reference bag on the side of the OPD that has the USB2000 device.
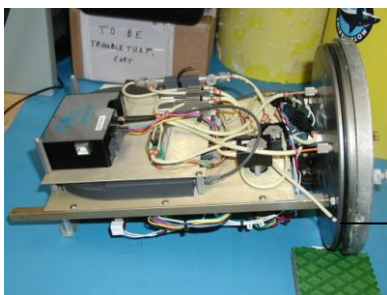
Units' CDOM Reference PharMed® tube.

2.	Screw on the two screws at on end to the units' frame and the bolt on the other end of the unit.

3.	Connect PharMed® tubing from unit to barb on the CDOM reference bag.

3.3 Checking 0- ring Seals

O-Ring location

Regular maintenance of the two O-rings is crucial to avoid water leaks in your unit. Recommended O-ring lubrication:

- Parker O Lube Lubrication
- Poly SI Technologies Barium Grease O- Ring Lubricant

Always check the o-rings and grooves around o-ring for any debris. It is very important that it is clear of any particles and debris. Any interference with the seal WILL cause water leaks leading to major problems with the instrument.

3.4 Cleaning the Phytoplankton Optical Discriminator

Objectives: To clean the LWCC and the internal tubing of the OPD. The best way to check the status is to use the Integration time for a marker. The other way is to monitor the pressure on the internal filter. Both of these Sensors are reported in the Status message. Refer to Section 2.9 in the user manual (page 17) for the Status message example.

To use Integration time for an indicator, note the *Int time* when first using the unit; it should be at an adequate value to begin usually ranging between 30 to 50 ms; although this value will vary for each unit.

The *Int time* is a value referencing the length of time the spectrometer collects pixels to maximize the peak spectrum of each cycle. When the value of Int time is greater than 200 ms you should check or clean the unit.

Materials used for cleaning:
- Waste beaker
- 3 x Peek tubing port extenders
- Cleaning Solution #1
- Methanol Solution #2
- 2N HCL Solution #3

If the OPD is open you can use the CDOM-Ref connection, if it is not open you will have to use the Sample ports on the bulkhead of the OPD.

To use the CDOM-Ref connection and Reference Pump:

1. Connect sample port tube extenders. Insert into waste beaker to collect fluids.
2. Setup CDOM-Ref pump and extender to make ready to pump in solution or water.
3. First select, *Select Closed* ; this will close the Sample filter flow off so the water only goes through the LWCC and CDOM-ref tubing and out the bulkhead ports.
4. Select *Reference Pump On* before connecting any fluids. Note: this will pump any fluid out of sample port A or B. Select *Valve Toggle* to clear both sample ports of fluid on every pumping cycle. When cleared, select *Reference pump off*.
5. Setup water or solution to be used.
6. Select *Reference Pump On*. Let it pump until the solution pumps out of port A or B.
8. Select *Valve Toggle* and let run until solution comes out the opposite port.
9. Select *Ref pump off*.
10. Let solution settle for 5 minutes and flush with Nano pure.
11. Repeat this process with solutions #1 through #3 until the LWCC is clean.

Note: There is an extra command to help with cleaning, *LWCC Flush.* This command is only for use with the Reference Pump. The command will turn on the Reference pump briefly and reverse the Reference pump back and forth multiple times. This command should only be used in-between fluids in cleaning cycles.

To use the Sample port connections and Sample Pump:

1. Connect sample port tube extenders and insert one into waste beaker to collect fluids and the other into Cleaning solution or water.
2. Select, *Select Bypass*; this will bypass the filter.
3. Put both sample port extenders in the waste beaker.
4. Select *Sample Pump On* before connecting any fluids. Note: this will pump out any fluid. Select *Valve Toggle* to clear both sample ports of fluid on every cleaning cycle. When cleared, select *Sample pump Off*.
5. When doing step 4. note which valve you are on.
6. Select the appropriate Valve to pump in fluid by using the *Set Valve A* or *Set   Valve B* commands
6. Select *Sample Pump On*. Let it pump until the solution pumps out of port A or B into the waste beaker.
8. Select *Sample Pump Off*.
9. Select *Valve Toggle* or select opposite port A or B.
10. Switch the sample port extenders and select *Sample Pump On* run until solution comes out the opposite port.
11. Select *Sample Pump Off*.
12. Let solution settle for 5-10 minutes and flush with Nano pure.
13. Repeat this process with solutions #1 through #3.
14. When finished with cleaning pump in Nano pure water and use the command *Adjust Int Time*, this will give to new Integration time and an idea if the cleaning process is working or needs to be repeated.

Glossary

Adj(ust) int(egration) time appears at the beginning of a cycle run. It is best when the value is low (x-y), indicating there is no debris in the LWCC chamber. The value should remain similar through out all the cycles, with little fluctuation, in order to obtain accurate results. If the value does start to increase, there is either debris clogging the tubing or possibly an air bubble.
BSOP is a type of high pressure unit.
CDOM filtered sample water.
CDOM Reference is a mixture of filtered sample water with HCL.
Cell is a configuration for using a cell phone modem.
Dark appears when running a cycle and the light is off. The number of pixels will be low.
Discriminate is non-filtered sample water.
Debug is a feature that writes data to screen during the progress of each cycle.
Nohost mode when selected, will automatically start a cycle, base on the sampling setup for each unit.
Polled is the ability to make the OPD query or listen for a <status> command before it reports the status message.
Sim is simulation mode. It uses parameters set up in the configuration for the cycles but simulates the cycle and the results.
.PXE
Is a Persistor created extension. Everything with this extension is necessary for OPD to work.
Files with this extension are found din the main root directory.
AUTO.BAT
A file that is executable.
Automatically loads a file when powered up.

Appendix A: Installing OPD Setup & control on your computer

On the web, go to http://coolgate.mote.org

A password is required to enter into Downloads. Contact our technical support for the password.
Once logged in, click on OPD Setup & Control.
OPD Installer.txt will have instructions on how to download to your computer:

```
1. Unzip OPD Setup&Control to a local folder.

2. Run setup.exe

3. Run regscom.bat
Default location
c:\Program Files\Phytoplankton Ecology\OPD SetupControl

4 Launch OPDSetupControl.exe
```

Appendix B: Setup Default Values

cycles to do	1
cycle time	0
set time to local	No
set time to GMT	Yes
disc rerpeat rate	1
message on	Yes
message off	No
CDOM ref. Interval	9
CDOM ref.flush time	60
CDOM ref. Supply ml	0
CDOM ref. on	No
CDOM ref.off	Yes

Appendix C: Low pressure Opcodes

Parameter	Opcode
Sampling	
Start	<cycle>
Stop	<stop>
Exit	<closedown>
Status	<status>
Setup	
cycles to do	<numbercycles> &I
cycle time	<cycletime> &I
Set time to Local	<timesync> &L
Set time to GMT	<timesync> &Z
Disc repeat rate	<discrepeat> &I
Messages on	<debugon>
Messages Off	<debugoff>
Cdom ref interval	<cdomrefrepeatrate> &I
Cdom ref flush time	<cdomrefflushtime> &I
CDOM ref Supply mL	<cdomrefmliterleft> &I
CDOM reference on	<cdomrefon>
CDOM reference off	<cdomrefoff>
Reports	
Sampling Setup	<opcode> 21
Sensors report	<opcode> 14
LP OPD Commands	
Adjust Int Time	<opcode> 17
Shutter Open	<opcode> 2
Shutter Closed	<opcode> -2
Lights On	<opcode> 3
deuterium on	<opcode> 35
Tungsten on	<opcode> 36
lights Off	<opcode> -3
Select Filter	<opcode> 4
Select Bypass	<opcode> 5
Select Closed	<opcode> 6
Reference Pump On	<opcode> 8
Reference Pump Off	<opcode> -8
sample Pump On	<opcode> 7
sample Pump Off	<opcode> -7
set Valve A	<opcode> 10
Set Valve B	<opcode> -10
Valve Toggle	<opcode> 15
Status Report	<opcode> 52
LWCC Flush	<opcode> 43

Appendix D: Connectors


```
        +12V
         ⊙
         1
12V out ⊙   ⊙ GND
        5   2
    TX  ⊙   ⊙ RX
        4   3
      MCBH-5-MP
```

```
        +12V
         ○
         1
GND ○       ○ 12V out
    2       5
 RX ○       ○ TX
    3       4
      MCIL-5-FS
```
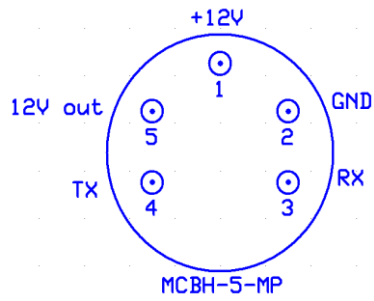
Bulkhead Connector	In- line Connector
(Looking at pins)	(Looking into sockets)
MFG: Impulse or Seacon	MFG: Impulse or Seacon

Appendix E: OPD error codes

Explains summation of codes to become OPD Status

```
Leak                    0x01
PumpTimeOut             0x02
FullSpeedToEndOverrun   0x04
GotoXOverrun            0x08
SameSpeedToEndOverrun   0x10
Valve failure           0x20
Spectrometer error      0x40
Deuterium light failure 0x80
Tungsten light failure  0x100
```