Mesocosm User Manual

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Contents

Chapter 1

Summary

This manual describes the design, operation, and maintenance of the mesocosm aquaria, located in the loading bay between Citrus Hall and Eucalyptus Hall at California State University, Northridge, funded and operated by Dr. Nyssa Silbiger.

Chapter 2

Contacts

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Chapter 3

System Details

Contents
- **Aquaria System**
- **Filtration and Recirculation System**
- **System Operational Parameters**
- **Apex Connection Series**
- **EB832 Outlet Connections - Water Flow Operation**

Aquaria System Component List

- Experimental Tanks (21.25” x 12.5” x 13.5”H) - Per tank:
- 1 Submersible powerhead pump (Hydor Nano Koralia 240 powerhead)
- 1 200 W Heater (Hydor aquarium heater)
- 1 Light (Halo Basic M-110)
- 1 Temperature probe (Apex)
- 1 pH probe (Apex)
- 1 Solenoid valve for pH (Apex)
- 3 Flow sensors (Apex, FS-25 1/4” fitting, flow rates from 3-12 GPH (12-45 LPH))
- 1 Main Supply line: “N”
- 1 Solenoid Supply line: “S”

- 1 Drain line: “D”
- 1 Gate valve (solenoid for water inflow)
- 1 VDM (Apex Variable Dimming Module, 1 unit for 4 tanks)
- 1 FMM (Apex Fluid Metering Module)
- 1 PM1 (Apex Probe Module 1)
- 1 Base Unit (Apex processing unit, 1 unit for 4 tanks)
- 1 EB832 (Apex 8-outlet EnergyBar, 1 unit for 2 tanks)
- 1 CO2 regulator valve (Tunze pH Controller Set, pressure reducing valve 7077/3)
- 1 Industrial Grade Carbon Dioxide, 50 pound cylinder

Filtration and Recirculation System Component List

- Sump (66.25” x 31.5” x 21”H)
- Chiller (AquaLogic Multi-Temp and Titan Series)
- Heat Pump (AquaLogic Multi-Temp and Titan Series)
- PM1 (Apex Probe Module 1)
- Water pump (PerformancePro Cascade pump)
- UV Sterilizer (Comet Series 95 Watt Lamp)
- PhosBan chemical filter (PhosBan Reactor 550)
- Air compressor
- Airstones (4 units on 4 outflow tubes)
- Carbon filter cells (3 units, CF28AC,28in, ActC)
- Mesh filter (8 units, Matala Filter Media, interchanged 4 Blue high density and 4 Black low density sheets)

System Operational Parameters

- This is a closed loop system where water from each individual tank will recirculate back to a main holding reservoir (sump).

- Normal High Tide operating water level is approximately 12.5“H for a total water volume of 14.37 gal per tank (287.4 gal total for the 20-tank-system).

- Normal Low Tide operating water level is approximately 4“H for a total water volume of 4.60 gal per tank (92.0 gal total for the 20-tank-system).

- Excess water volume to sump at low tide is 9.77 gal per tank (195.4 gal total for the 20-tank-system).

- Normal sump operating water level is 7” water in the filter cell compartment, which has an approximate volume of 82.32 gal. Sump freeboard volume is 107.39 gal.

- Aquaria drain line is in line with a 30 gal sump pump, which will draw water from the aquaria drain line and pump water to the sump.

- Sump is in line with a secondary holding tank for sump overflow at Low Tide.
  - 195.4 gal returning to sump in a Low Tide scenario
  - 30 gal in sump pump
  - 107.39 gal in sump (freeboard volume)
  - 58.01 gal necessarily pumped to secondary holding tank

- Flow rate for each tank is 2-6 GPH (See Tidal Manipulation for specific flow rates).

- Chiller is plumbed inline with the filtration skid which includes mechanical/biological filtration as well as UV sterilization (chemical filtration).

- One main pump recirculates the water flow throughout the experimental tanks and the main holding reservoir.

- Each tank has an immersion heater that allows tank temperatures to be set 15 degF (8.3 degC) above the main holding tank reservoir.
  - **Note: The tank needs to have low flow or be static in order to heat up to a desired temp. Once the temperature has been reached then it can be set to normal operating flow through mode.**

- A small sumbersible powerhead in each tank provides water circulation

throughout the tank.

- Each tank has (2) supply lines, each with (1) Neptune Systems flow sensor and (1) needle valve for incoming flow rate control, and (1) gate solenoid valve in line with (1) supply line for tidal effect. Each tank also has (2) drain lines with (1) flow sensor in line with (1) needle valve for outgoing flow rate control. Incoming and outgoing flow rates have to be manually adjusted for the tidal effect.

- Flow metered water lines
  - N: Main supply
  - S: Solenoid-controlled supply
  - D: Drain

- Tidal effect
  - outgoing tide: incoming flow rate (N + S) is lower than outgoing flow rate (D).
  - incoming tide: incoming flow rate (N + S) is greater than outgoing flow rate (D).
  - Note: The tank will not be completely empty during low tide events to prevent the recirculating powerhead from running dry.

- Each tank has (1) CO2 supply line with an airstone connected to (1) Neptune Systems solenoid valve to control and lower pH in tanks.

- CO2 scrubber comprised of an air compressor connected to a Phosban Reactor will bubble air into the sump to bring pH to ambient or near-ambient conditions in the holding reservoir.

- Each tank has individual LED lighting, which can be controlled for white or blue light by specific times or natural daily light cycles.

- Certain tank conditions can be controlled via Neptune Systems Apex Controllers. Each Apex controls (4) tanks.

- Controllable parameters are pH, temperature, tidal effect, and lighting.

Apex Connection Series

- Each EnergyBar connects to the Base Unit with an AquaBus cable via the AquaBus Ports for power. (2) EB832 units connect to (1) Base Unit.

- Each CO2 Solenoid valve connects to the EnergyBar via the DC24 Accessory Port on the side of the EB832. (2) Solenoid valves connect in (1) EB832.

- (1)PM1 connects to (1) EnergyBar with an AquaBus cable via the AquaBus Ports, and all PM1 modules connect in series with each other for power.

- VDM connects to the last PM1 in series with an AquaBus cable via the AquaBus Ports for power.

- Temperature probes connect to the PM1 Temp Port or the Base Unit Temp Port. (1) Temperature probe in each PM1, and (1) Temperature probe in the Base Unit.

- pH probes connect to the PM1 pH/ORP Port or the Base Unit pH/ORP Port. Push the BNC female connector of the probe on to the male connector and turn 1/4 turn clockwise to lock the connector in place. (1) pH probe in each PM1, and (1) pH probe in the Base Unit.

- Halo light connects to the VDM or Base Unit via the V1/V2 or V3/V4 Port. (2) Light connections in the VDM and (2) Light connections in the Base Unit.

- (1)FMM connects to (1) EnergyBar (whichever EB832 is not powering the PM1 modules) with an AquaBus cable via the AquaBus Ports, and all FMM connect in series with each other for power.

- (3)Flow sensors connect to each FMM via (3) of the numbered ports.

EB832 Outlet Connections

Note: Each horizontal row on an EB832 corresponds to one tank, yielding 4 outlets per aquarium. Current outlet order, left to right:

1. 200W Heater
2. Hydor Powerhead
3. Water supply line “S” Solenoid
4. Halo Light

Water Flow Operation

- Inflow from the filtration sump to the mesocosm tanks
  - Water from the chiller can be directed either back into the sump (the bypass t-valve is parallel to the pvc, opening flow to the sump, and

the tank t-valve is perpendicular to the pvc, closing flow to the tanks) or to the mesocosm tanks (the bypass valve is angled to allow partial flow to the sump and tanks, and the tank valve is parallel or angled with the pvc, opening flow to the tanks).
  - The bypass valve is used to regulate the line pressure going back to the mesocosm tanks. The more closed, the higher the pressure in the line, and the more open, the lower the pressure.
  - The chiller has a safety flow switch that requires a minimum flow rate for the chiller to operate, so the bypass valve can be used to regulate the chiller flow as well as the container flow.

- Outflow from the mesocosm tanks to the filtration sump
  - Water from the tanks drains to an outdoor underground sump pump, which will automatically pump water out when a certain water level is reached. This water can be directed either back into the sump (the sump inflow t-valve is opened parallel to the pvc, allowing flow to the three dump pipes into the filtration skid), or if you intend to drain water in the event of a water change or the end of an experiment, water can be directed to a drain port (the sump inflow valve is closed and the drain t-valve along the South wall is opened parallel to the pvc).

- Overflow from sump to secondary containment
  - When mesocosm water level falls from a high tide to low tide sequence, more water will drain to the sump than what the main sump can individually hold. Excess water can be redirected from the sump (S1) to the secondary containment (S2) by opening the S2 inflow t-valve (allows simultaneous flow of filtered, chilled water to both S2 and the mesocosm tanks), and the overflow t-valve (allows continuous flow exchange between S1 and S2).

Chapter 4

Inventory

Contents
- Experimental Mesocosm - Filtration - Spare Items

Experimental Mesocosm

Item	Quantity	Purchase Replacement
Experimental Aquarium	20	
Aquarium Lid	20	
200W Heater	20	$24.99 Amazon
Suction Heater Slip	40	
Halo Light	20	$299.99 Amazon
Halo Light Power Cords	20	
Hydor Powerhead	20	$34.99 Amazon
Temperature Probe	20	$29.95 Bulk Reef Supply
Suction Temperature Probe Slip	20	
pH Probe	20	$74.95 Bulk Reef Supply
Suction pH Probe Slip	20	
Salinity Probe	5	124.95 Bulk Reef Supply
pH and Salinity Calibration Pack 7, 10	10	$6.85 Bulk Reef Supply
CO2 Solenoid Valve	20	$29.95 Bulk Reef Supply
FS-25 1/4” Flow Sensor	60	$19.95 Bulk Reef Supply
Flow Solenoid/Gate Valve	20	$16.99 Electric Solenoid Valves
Inflow Seawater Tubing	40	
Inflow CO2 Tubing	20	
Airstone	20	$5.99x10pack Amazon
Inflow Tubing Stand	40	
VDM	5	$99.95 Bulk Reef Supply
FMM	20	$99.95 Bulk Reef Supply
PM1	16	$84.95 Bulk Reef Supply
Display Module	1	$99.95 Bulk Reef Supply

Item	Quantity	Purchase Replacement
Apex Base Unit	5	$399.95 Bulk Reef Supply
Apex EB832	10	$249.95 Bulk Reef Supply
Tunze CO2 Regulator Valve	1	
180gal Sump	1	
Chiller	1	

Filtration

Item	Quantity	Purchase Replacement
PhosBan Reactor 550	1	$85.14 Bulk Reef Supply
PhosBan CDX Carbon Dioxide Absorption Media 3L	1	$44.38 Bulk Reef Supply
Cascade Water Pump	1	
UV Sterilizer	1	
UV Light	1	
Air Pump	1	
Air Pump tubing to Phosban Reactor 3/8” ID x 10’	2	$4.93 Home Depot
Airflow Tubing 3/16” ID x 8’	4	$2.69 Petsmart
Airstone	4	
Carbon Filter Cell	3	
Matala Filter, High Density (Blue)	4	
Matala Filter, Low Density (Black)	4	

Spare Items

Item	Quantity
Solenoid Valve	4
Flow Solenoid/Gate Valve	5
Halo Light	1
Airstone	29
Halo Light-to-Light Cable	16
pH Calibration Pack $7, 10$	3
Salinity Calibration Pack $53,000uS$	3
FS-25 1/4” Flow Sensor	0
pH Probe	0
Conductivity Probe	0
Temperature Probe	0
Hydor Powerhead	0

Chapter 5

Start-up Guide

Contents
- **Basic Operation**
- **Filtration**
- **Sump Flow - Mesocosm Tank Flow - CO2 Scrubber**

Basic Operation

1. Operating water level in the filtration sump should be 7" in the filter cell compartment.
2. Overflow water from the tanks will feed down to the outside underground sump pump, then into to the filtration skid inside the Citrus Hall Field Room. The water will flow through mesh filters and be pumped through carbon filters, the UV sterilizer, and chiller, then back to the tanks.

Filtration

- Biological and Mechanical Filtration: Water from the Mesocosm tanks is pumped into the sump by passing through 6 mesh filters. These filters have an accumulated biofilm to biologically filter the water before it enters the sump.
- Chemical and Mechanical Filtration: Water in the sump is pulled through the three carbon filters with mesh filter sleeves by a pump and pushed up into the UV sterilizer, where is is then directed through the chiller chamber.

Sump Flow


PerformancePro
Cascade


COMET
SERIES UV STERILIZER
aquaLOGIC


EPDM AEROCEL AC 2350 UV
EPDM

Mesocosm Tank Flow

1. Filling the mesocosm tanks
    1. Make sure the drain valve located under each tank is closed (turned clockwise all the way, finger-tight).
    2. Open the N flow valve for each tanks (and S flow valve if you're turning the Solenoid ON to fill the tanks).
    3. To open flow from the sump to the tanks, first make sure the circular flow within the sump itself is stable. Then slowly open the t-valve (turn counterclockwise) till the t-valve is sitting about 45 degrees to the PVC pipe. This splits flow to both the sump and now the mesocosm.
    4. Fill each rack one at a time (only open the N flow valves for one set of 4 tanks at a time) and make sure rack and filtration skid flows are balanced before moving on to the next rack.
    5. Make sure the complete system reaches equilibrium in standard recirculation mode before setting up the tidal cycle.
2. Set flow in tanks
    1. Calculate your desired residence time. When full, each tank holds 55 liters, so divide 55L by your desired residence time and use that estimated value as your flow rate. Example: for a RT of 8 hours: 55L/8hr = 6.88 L/hr or 114.67 mL/min
    2. If you have an acceptable range for your residence time, set flow rate to within that range, as close to your desired flow as possible. Example: for a RT of 7.5-8.5 hours: RT = 6.47-7.33 L/hr or 107.83-122.17 mL/min
    3. Use the Neptune Systems flow meters as a guide for setting the flow, but for the most accurate flow rates, use a graduated cylinder to estimate flow into each tank.
    4. Flow will slightly change throughout the day, so it is recommended to set flow twice per day: once in the morning and once in the afternoon/evening.

CO2 Scrubber 1. Replacing media in the Phosban Reactor 1. Unplug the airpump connected to the Phosban Reactor and disconnect both sets of tubing going into/out of the Reactor tube to easily remove and work wtih the Reactor tube. 1. Unscrew the lid of the Reactor, take off the red cap and black mesh, and pour out the used up media (purple if freshly used up, grayish white if used and stale) into a bag or some containment. 1. Use tape or parafilm to cover the hole of the small tube inside the Reactor before pouring in the new media (stark white pellets). Fill to an inch **below** the top of the small tube, so no media falls into the tube. Remove the covering from the small tube and replace the black mesh and red cap, aligning the red cap so it encapsulates the small tube. 1. Screw the lid back on, finger tight, and replace the tube on the side of

the sump. Reconnect the tubing from the airpump to the side of the Reactor tube and from the air splitter to the front of the tube. 1. Once you're sure everything's securely placed, plug in the air pump. 1. Listen and feel for any air leaks and adjust tubing as necessary.

Chapter 6

Tidal Manipulation

Controling the tidal cycle of each experimental tank with the Apex. This is achieved by manipulating the incoming and outgoing flow rates of each individual tank with the needle valves described in the System Details, and setting the ON/OFF time cycle of the supply line with the solenoid. The basic procedure is outlined below.

1. Set the flow rate of the supply line N[#]FLW (without the solenoid), for example 10.5 Liters/Hr, by slowly turning the black knob counterclockwise to increase flow or clockwise to decrease flow.
    1. You can view rates on the Fusion dashboard.
    2. Note that the Apex controller has some lag time in registering the flow rate after the valve has been adjusted, and the delay can be up to 30 seconds or more, so make small adjustments and monitor the change on Fusion.
    3. Once the rate is set you should check periodically to make sure the rate has not changed both on Fusion and by using a graduated cylinder and a timer.
2. Adjust the outgoing flow rate of the drain line D[#]FLW higher than the N[#]FLW, for example 15 Liters/Hr.
    1. With the above condition, the outgoing flow rate is higher than the incoming, so this will create a low tide effect over a 5-5.25 hr period.
3. To create a high tide effect, change the setting of SOL-TNK-# (outlets 3 and 7 on each EB832) to ON on the Fusion dashboard, then manually turn on and adjust the flow rate of the supply line S[#]FLW , for example 10 Liters/Hr.

4. Once the S[#]FLW is set, change the setting of SOL-TNK-# to AUTO on the Fusion dashboard.

1. With the above condition, the total incoming flow rate (N+S) is higher thatn the outgoing (D), so this will create a high tide effect over a 5-5.25 hr period.
2. For a constant ON/OFF cycle over a 12.5 hour period, the Advanced program should look like the program below:

Fallback ON
Osc 000:00/375:00/375:00 then ON

1. In the event the EnergyBar loses connection with the Apex Base, "Fallback ON" will keep the solenoid open, allowing water to continuously flow from S[#]FLW.

2. The oscillate (Osc) command as written will open flow from S[#]FLW for 6.25 hours, initiating the High Tide scenario, then close for 6.25 hours, initiating the Low Tide scenario. This will provide the effect of two high and two low tides of a semidiurnal tidal cycle over a 25 hour period.
    1. Using the flow rates stated above, each tidal shift will last 5.25 hours and maintain the tide height for 1 hour.

For more advanced programming features, see the Comprehensive Manual. Start on Page 65 for Seasonal Features and Moon cycles.

Chapter 7

Controlling pH

The pH is controlled with the addition of CO_2 gas to the system. The gas is delivered to the tank by air stone and is controlled through the Apex Controls with a solenoid valve connected to the EB832.

1. Once the CO_2 regulator is connected to a tank, open the main tank valve.
2. Use the pressure adjusting screw (larger knob in front with Tunze label) to adjust the pressure (in bar) on the pressure gauge. Turning **clockwise to open**, thus increasing pressure, while turning **counterclockwise to close**, thus reducing pressure.
3. The pressure should be set to 0.5 up to 1 bar on the gauge (~7.5psi) - ideally 0.6 bar.
4. Open the fine adjustment valve (smaller valve next to the tubing connecting the regulator to the tanks) to allow gas to the tank solenoid. If the pressure on the gauge is too high this may prevent the CO_2 solenoid from completely closing, which will inject excess CO_2 into the system.
5. Programming the solenoid for a consistent pH: pH-TNK-#

Control type: pH Control
Probe name: pH
Fallback: OFF
High Value: 8.2
Low Value: 7.9
On when: High

6. Programming the solenoid for diel variance:

- Using Advanced programming and Virtual outlets

- Create a unique virtual outlet for every time block which requires a different pH, and for every tank/probe which requires that pH treatment. *Virtual Outlet Example (for the 6 hours between 6:31am and 12:30pm, the CO2 solenoid will dose CO2 into tank 1 while the probe reads 8.10 or above): Fallback OFF Set OFF If Time 06:31 to 12:30 Then ON If pH-1 $<$ 8.10 Then OFF

*Advanced Program Example (Every 6 hours, the pH setpoint changes, and each of the four time block has a unique virtual outlet name, as presented below in the four programming lines. The CO2 solenoid will dose the tank when the conditions of the virtual outlet program are met): Fallback OFF Set OFF If Output pH_1_630 = ON Then ON If Output pH_1_1230 = ON Then ON If Output pH_1_1830 = ON Then ON If Output pH_1_0030 = ON Then ON

Refer to Comprehensive Manual for set point programming.

Chapter 8

Apex Programming Guide

Recommendations for programming the Apex aquarium controllers designated for the Silbiger Lab Mesocosm, located in the loading bay between Citrus Hall and Eucalyptus Hall at California State University, Northridge. These recommendations are for maintaining tanks at ambient conditions. Changes should be made according to your study aims.

The following are using the numbered system of Apex1_39106, controlling tanks 1-4. All methods are transferrable across all 5 Apex controllers to yield the same outcome in all 20 tanks, or change programs for varied results.

Contents
- **Accessing the Programming Edit Screen in Apex - **Probes**
- **Modules, Outlets, and Ports**
- **Outlet Setup in ApexFusion**
- **Profiles**

Accessing the Programming Edit Screen

1. From the ApexFusion Dashboard, select the Expand icon (gears) from the top toolbar to provide more options.
    - Outputs: grants access to the page controlling all outlets and connected items that are programmable by the apex
    - Profiles: create a scenario that can occur if some condition is met for an Output program (see example with the Lights below)
    - Modules: to update, rename, or set units for a module connected to the Apex
    - Inputs: to calibrate, rename, or set units for any probes and other inputs providing data to the Apex
    - Misc Setup: to restart the apex or set the frequency of data logging
    - Network Setup: to manually configure network settings or check current network settings

2. The most utilized option above is often Outputs, where you can program anything plugged into the Apex. Select this icon.
3. You can either select an output already configured to program that outlet, or create a "Virtual Outlet", which, similar to profiles, allows you to program a particular condition that if true, can trigger some other action in the program of a "real" Output.
    - When using a Virtual Outlet in programming a "real" Output, select Advanced prgoramming and use the folling line as an example: If Output your_output_name = ON Then ON
4. For all other Outputs, you can use the drop down menu to select the type of item you're programming for a fill-in style program option, or select Advanced to create your own program.
    - Examples of Advanced programming for different types of Outputs are below and in the controlling_pH guide.

Probes

- Salt-1 (Base)
- TMP-1 (Base)
- PH-1 (Base)
- TMP-2 (PM1_2)
- PH-2 (PM1_2)
- TMP-3 (PM1_3)
- PH-3 (PM1_3)
- TMP-4 (PM1_4)
- PH-4 (PM1_4)

Modules, Outlets, and Ports

- Base Unit Variables
- WHITE-TNK-1
- BLUE-TNK-1
- WHITE-TNK-2
- BLUE-TNK-2
- Base Unit Alarms

- SndAlm_I6
- SndWrn_I7
- EmailAlm_I5
- EB832_1
- HEATER-1
- PWRHD-1
- SOL-TNK-1

- LIGHT-TNK-1
- HEATER-3
- PWRHD-3
- SOL-TNK-3
- LIGHT-TNK-3
- PH-TNK-1
- PH-TNK-3
- EB832_2
- HEATER-2
- PWRHD-2
- SOL-TNK-2
- LIGHT-TNK-2
- HEATER-4
- PWRHD-4
- SOL-TNK-4
- LIGHT-TNK-4
- PH-TNK-2
- PH-TNK-4
- VDM
- WHITE-TNK-3
- BLUE-TNK-3
- WHITE-TNK-4
- BLUE-TNK-4
- BluLED_11_5
- WhtLED_11_6
- FMM_1
- S1-FLW
- N1-FLW
- D1-FLW
- FMM_2
- S2-FLW
- N2-FLW
- D2-FLW
- FMM_3
- S3-FLW
- N3-FLW
- D3-FLW
- FMM_4
- S4-FLW
- N4-FLW
- D4-FLW

Outlet Setup in ApexFusion
All configurations are for Control Type: Advanced

- HEATER-#

- Fallback OFF
  Set OFF
  If Tmp-# < 17.0 Then ON

- PWRHD-#
- Fallback ON
  Set ON

- Alternative program is to set Control Type: Always

- SOL-TNK-#
- Fallback ON
  OSC 000:00/375:00/375:00 Then ON (for tidal oscillations)

- Log Enabled

- LIGHT-TNK-#
- Fallback OFF
  Set OFF
  If Sun 0/0 Then ON
  If Moon 0/0 Then ON

- Log Enabled

- PH-TNK-#
- Fallback OFF
  Set OFF
  If pH-1 > 8.10 Then ON (for more specific examples, see controlling_pH(#controlling_pH))

- Log Enabled

- WHITE-TNK-#
- Fallback OFF
  Set OFF
  If Sun 0/0 Then RampUp

- BLUE-TNK-#
- Fallback OFF
  Set OFF
  If Moon 0/0 Then RampUp

- WhtLED_#
- Fallback OFF
  Set OFF
  If Sun 0/0 Then ON

If Tmp-# > 35.0 Then OFF
Min Time 030:00 Then OFF

- BluLED_#
- Fallback OFF
  Set OFF
  If Moon 0/0 Then ON
  If Tmp-# > 35.0 Then OFF
  Min Time 030:00 Then OFF

Profiles

- RampUp:
- Type: Ramp
- Ramp Time: 30 min
- Start Intensity: 0
- End Intensity: 100

Chapter 9

Apex Fusion

To access the Silbiger Lab Fusion account, go to ApexFusion.com, click "Get Control" and enter the login information:
Username: SilbigerLab
Password: silbigerlab

Contents
- **Dashboard Display**
- **Module Setup**
- **Outlet Setup**
- **Downloading Data Logs - Update System**

Dashboard Display

- Left column displays the current system time, Reminders, and Temperature and pH trending line graphs for each tank.
- Middle and right columns display the Watt, Amp, and Volt readings for each EB832, the state of each outlet (OFF, AUTO, or ON), and the flowmeter readouts for the N-valve (continuous inflow), S-valve (controllable inflow) and D-valve (outflow) for each tank.
- You can manually control the state of the outlet by moving the slide bar to either OFF or ON. To let the program settings control the outlet state, move the slide bar to AUTO.
- Adjusting the Solenoid status bar to OFF will stop flow from the S-valve, while adjusting the status to ON will open flow from the S-valve. Adjusting the status to AUTO will allow your program to control when the Solenoid opens and closes.
- To modify the dashboard (add, remove, or reorganize items), click the padlock icon in the upper right-hand corner then click and drag a tile to move it or click the "x" to store it in the upper tile bank.

Module Setup

1. Expand the Options menu and select the Modules icon to view all modules.
2. Click any module to view a summary of its connection and software status, rename the module, or perform an action with that module (Configure, Update Software, or Delete).

Outlet Setup

1. Click the Outlets icon in the upper left-hand options bar.
2. Outlets are arranged by the name you give them, the module they're associated with, the type of output, and whether or not you have chosen to log activity.
3. Select an outlet to modify its name, display symbol, and program settings.
    1. To use a program template, use the "Control Type" dropdown menu to select which item you intend to use in this outlet location, then fill in the required information to control the outlet state.
    2. To write your own program, select Advanced from the dropdown menu, and write your progrm in the source code box that appears.
4. Once you've completed your settings and program, click the orange cloud icon in the upper right to send your new settings to the Apex.

Downloading Data Logs

When connected to the same network as the Apex units, you can download data logs for the systems following the directions below.
Note To connect to the same network, you must plug your device into one of the live ethernet cables in the Mesocosm.

Format for your internet browser URL:
http://:/cgi-bin/outlog.xml?sdate=yymmddhhmm&days=n
http://:/cgi-bin/datalog.xml?sdate=yymmddhhmm&days=n

- Accessible logs:
- Outlog – every time the Apex changes the state of an outlet a record is written to this log. If no outlet ever changed state you would have zero records in this log. A new log is started daily at midnight. Log is named "yymmdd.odat".
- Datalog – records probe value snapshots (Temp, pH, ORP, etc.) based on the logging interval you define (default = 20 minutes). You can change the interval via the Display module under Data Log – Log Interval. A new log is started daily at midnight. Log is named "yymmdd.pdat".

Examples of what to enter into your internet browser:
http://172.24.113.25/cgi-bin/outlog.xml?sdate=191005
http://172.24.113.25/cgi-bin/outlog.xml?sdate=191005&days=7

- The value after date= is the start date for when you want logged information, and days=n yields data n days after that start date.
- Hours and Minutes are optional in the date parameter.

1. Following the above format, enter the unique IP address for the Apex containing the logs you want to access.
    1. Apex_39106: 172.24.113.25 Apex_40216: 172.24.113.22 Apex_39952: 172.24.113.23 Apex_37810: 172.24.113.21 Apex_41239: 172.24.113.24
2. Import Log Data (Windows/PC)
    1. Open a new Excel file and go to the Data tab
    2. Select From Web in the Get External Data box
    3. A New Web Query dialog box will open. Type or copy the url from your browser into the data source Address field. Click Import.
    4. Your XML data should be imported into your empty spreadsheet and automatic filters created for each column making it easy to select and analyze data.
3. Import Log Data (Mac)
    1. Open the web browser for the apex data you want to downlaod
    2. Wait for the page to fully load (the top line of the page will read "This XML file does not appear to have any style information associated with it. The documnet tree is shown below.")
    3. Right click somewhere on the webpage and click Save As.
    4. Save your file in an accesible location or in your R workspace with a name identifying the apex unit and date. Ex. 39106_191127d6.csv identifies Apex_39106, that data starts on 11-27-2019, and that data is saved for up to 6 days after the start date (12-3-2019). Manually type .csv to save the file as a csv instead of an xml file.
    5. Refer to Mesocosm_Environmental_Data/Datalog_Data_Tidy.R for a guide to clean up the data into a usable format.

Update System

1. From the Apex List menu
    1. If the orange icon next to the apex name shows an upward facing arrow in a circle, click that icon and select "Update Available" from the dropdown menu.
    2. The popup window will display the current AOS version and the most recent AOS version available for the system. If the popup says "it's recommended that you update", then make sure the Apex is connected via ethernet cable and click "Update".
2. From the Dashboard Display

    1. Click the down arrow next to the apex name in the upper left corner and select “Network” from the dropdown menu.
    2. Under “Apex Operating System” you can view the installed AOS and Available AOS. If the installed version is out of date, there will be an orange bar next to “AOS Update” reccommending you “Update AOS”. Click the bar, then make sure your Apex is connected via ethernet cable and click “Update”.

3. Once the system has completed the update, go to your Modules page. If any modules need to be updated (under “Status” there will be an error icon rather than a check mark), click that module and change the Configuration Action to “Update Software” then click the orange cloud icon.

Chapter 10

Breaker Box Connections

Following switches from top-down, then left-right:

1,3: Main Disconnect
5,7: Air Conditioner
9,11: Condenser (Chiller, Filtration)
2: General Power (Lights and Outlet Box #1)
4: Outlet Box #2 (Tanks 17-20)
6: Outlet Box #3 (Tanks 13-16)
8: Outlet Box #4 (Tanks 9-12)
10: Outlet Box #5 (Tanks 5-8)
12: Outlet Box #6 (Tanks 1-4, outdoor sump pump)

Powering the container:

1. Turn on (flip left to right) the Main Disconnect switches. Once powered, the remaining switches will supply power to their individual breakers.
2. Turn on (flip right to left) the General Power switch. Once powered, the light switch to the right of the entrance will turn on/off the overhead light, the O2 sensor above the light switch will be activated, and all outlets in Outlet Box #1 will be active.
3. Turn on (flip left to right) the Air Conditioner switches. Once powered, the A/C unit can be controlled via remote control or the front display panel on the unit.
4. Switches 4, 6, 8, 10, and 12 all correspond to outlet boxes lining the upper perimeter of the container. Each box is used to power up to two (2) Apex units and enough modules and other devices for up to four (4) tanks. Each outlet covering has a number corresponding to the labeling for these switches. To turn any or all on, flip the switch(es) right to left.
5. Leave the Condenser switches (9 and 11) in the "off" position unless the chiller and filtration system become connected

Chapter 11

Troubleshooting Guide

Contents
- **Loss of Power to the Sump/Tripped Breaker**
- **Flowmeter Misreadings**
- **Rebooting the Apex**
- **Sump Pump Malfunction**
- **Turning off Sump flow**
- **Light not responding to program - pH probe malfunction**

Loss of Power to the Sump/Tripped Breaker * Breaker tripped in the field room (pump, UV filter, CO2 scrubber all off) 1. If you just plugged in an item that correlated with the power shutting off, unplug that item. It may have tripped the breaker. 1. Check for other items plugged into EDP C-4 outlets that shouldn't be plugged in or seem out of place. Alert PPM of anything that shouldn't be plugged into those outlets (e.g. CSUN golf carts). 1. Make sure it's a tripped breaker and not the GFI outlet needing to be reset. 1. On the West wall inside the Field Room, just to the right of the secondary sump, there is a quadplex (4-plug outlet) that has a Reset button. Push that button until you hear a click. If you hear the click but the power is not restored, then follow the next steps. 1. This GFI outlet is also connected to the quadplex down by the sump on the South wall, so all 8 outlets are controlled by the GFI and could initiate the need for a Reset. 1. Call PPM (818-677- ext. 2222) and let them know a breaker tripped at Citrus Hall in outside room 3114 - the room next to the Mechanics Room on the outside and South side of Citrus Hall. 1. When PPM arrives, let them know the breaker box is on the 3rd floor of Citrus in Room 3303 and the switch is for EDP C-4

Sump Pump Malfunction and Turning off flow to the Mesocosm Tanks * If the sump pump (the outside underground pump between the Mesocosm container and the Field Room) stops pumping water to the sump, it will overflow out onto the concrete and into the loading bay driveway. * If you notice the pump has malfunctioned, do the following: 1. Check if the GFI outlet on the

outside of the Mesocosm container needs to be reset. On the 2-plut outlet, there is a Reset button. Push that button until you hear a click. If you hear the click but the pump does not respond (or you see the light at the bottom right corner of the outlet flash red), then follow the next steps. 1. Turn off flow to the Mesocosm tanks 1. There is a **T-valve** located along PVC which goes from the chiller to outside the Field Room. Turn this T-valve **clockwise** so it sits perpendicular to the PVC, closing off flow from the sump to the mesocosm, but retaining circulating flow within the sump. 1. The T-valve is in line with a PVC pipe running parallel to the sump, slightly above and to the side of the blue and black biofilter mesh.

Turning off Sump Flow * If a situation arises where you need to shut off the recirculating flow of the entire system, unplug the UV light from the South wall quadplex, then unplug the pump from the same quadplex. * If you would like to also turn off the CO2 scrubber, unplug both air pump plugs from the same South wall quadplex.

Flowmeter Misreadings * Flowmeter on ApexFusion is reading 0 or some incorrect value * Sometimes the flowmeters (FM) inline with water flow will either have a bubble or some debris affecting the spin of the turbine within the FM. 1. Make sure to check the flowmeter connections back at the FMM module for a connection issue. Unplug and plug back in the cable for the FM in question. 1. Try clearing bubbles. If gently tapping the FM doesn't resolve the issue, you may have to remove the FM to clear it out. * Removing the FM for cleaning 1. Turn off flow to the Mesocosm Tanks and wait 15-20 minutes to ensure there is no flow to the tanks. 1. Unscrew the FM at both of its compression fittings until the fittings are loose on the tubing, then pull gently at the tubings to remove them from the FMM (if the compression fitting is all the way unscrewed, but the tube isn't coming out of the FMM, pull a little harder beacuse sometimes the tubing just gets stuck in the FM). 1. Visually expect the inside of the FM, and if needed, use a small long object to probe and spin the internal turbine to dislodge any debris.

Rebooting the Apex
* If the Apex needs to be restarted for any reason, there are multiple ways to reboot the system. * Apex Fusion 1. Click the Expand Settings gears icon and go to the Misc page (wrench icon). 1. Under Power, check the box for Reboot: Restart Apex, then click the orange cloud in the upper right corner to send this command to Apex. Wait a few minutes for the devices to come back online. * Restart Button 1. Under the Apex Base Unit, above the pH port, there is a small hole encasing the Restart button. 1. Insert a push pin or small object until you feel the button press down and hold about 10 seconds. 1. If you require a full system reboot back to factory settings, hold this button for 1 minute. This will erase all modules, programming, log data, and probe calibrations, so be very sure.

Light not responding to program * Sometimes manually turning the light OFF on Apex, then back ON again, the light will function properly. * If Tank

13's light doesn't turn on when the program indicates it should be ON, go into Programming settings for Light-TNK-13, adjust the advanced program slightly (e.g. change an "ON" to an "OFF") and click the orange cloud to send to the Apex. Then change the program back to what it was before you made a change, and the light should turn on.

pH Probe Malfunction * If a pH probe is giving an 'off' reading, first calibrate the probe. 1. On your Fusion dashboard, click the gear symbol to the right of the pH reading to go to its settings. 1. Select Automatic Calibration, and follow the instructions, using new packets of 7 and 10 calibration solution. 1. When placing the probe into the calibration solution, swirl the probe in the solution a little before starting the reading. * If the reading is still off, go back into the pH probe's settings on Fusion and select Advanced to do a Manual Calibration. 1. Make sure Temp Compensate is Disabled then select Manual Calibration, and follow the instructions. 1. When placing the probe into the calibration solution, swirl the probe in the solution a little before starting the reading. Let the probe sit in the calibration solutions for about 5 minutes (or longer as necessary) to ensure a stable reading. * If the reading is still off after both the Automatic and Manual Calibrations, try a Factory Reset. 1. Go back into the pH probe's settings on Fusion and select and select Advanced. 1. Select Manual Calibration again, but this time just click "Next" through the steps quickly. Don't let the numbers settle. Then click "Finish". If the numbers for the 7 and 10 calibrations are the same, the probe calibration will be wiped and reset, ready for a new calibration. 1. From the Apex's "Misc" settings, check the box for Reboot: Restart, and click the orange cloud to send this command to the Apex. Wait for the Apex to fully reboot. 1. Run through the Manual Calibration steps again. * If after following the above steps, the pH probe is still malfunctioning, call Neptune Systems for support.

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