

AquaController

Apex and Apex Lite

Owner's Manual

Version 4.01A

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AquaController Apex Owner's Manual V4.01A
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1. Introduction

Scope of this Document

Congratulations, you have just purchased the most advanced aquarium controller on the market! It is recommended that you completely read the Owner's Manual before proceeding to set up the AquaController Apex to perform any task.

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2. Getting Started

Apex System Components

The Apex system is comprised of several different components which are described below.

Apex Base Module

The Apex base module is the main unit of the Apex system. It is the main processor which controls and monitors all other modules. The base module contains:

- Ethernet port with web server and email Alarms.
- Alternate power port.
- 2 AquaBus connectors for system expansion.
- A control port for legacy control equipment (DC8, DC4HD, LunarSim, etc.)
- 6 Digital inputs
- Temperature, pH, and ORP connectors (ORP connector not present on Apex Lite)
- 4 Variable speed (0-10V) ports (not present on Apex Lite).

Apex Display Module

This AquaBus module provides a high quality 128x64 backlit graphical display for the Apex Base module. The graphical display allows for custom fonts, icons, and graphs to be displayed. With its 7 button user interface menu navigation is quick and intuitive. In addition a second display module can be added to the system so that full user interface and display output is available in a remote location.

EnergyBars

The EnergyBar 8 allows for the independent control of 8 different devices, and multiple EnergyBars can be added to the system if additional devices need to be controlled. Like all AquaBus accessories it is plug and play and automatically recognized and configured by the Apex base module. The EnergyBar has a convenient 6 port AquaBus hub so that AquaBus accessories can be install in any topology which makes shortest less clutter connections possible. Strict daisy-chaining is not required. Total AquaBus cable length should be less than 200 feet.

Base Unit Installation

The following figure points out all the connectors located on the side of the AquaController Apex. Please refer to it during installation.

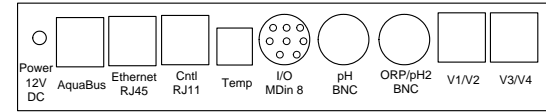


Figure 1: AquaController Apex Connectors

The AquaController Apex should be installed in a dry environment which has little chance of getting wet. The AquaController Apex system is a sensitive piece of electronic equipment and is not water proof. Ideally, it should be located several feet from the aquarium. Use screws to securely mount the display Apex base module.

If an EnergyBar is installed it will power the Apex base modules as well as any other AquaBus peripherals installed in the system.

If an optional 120 to 12V DC adapter is used to power the Apex, then it is recommended for it to be plugged into a surge protected power strip. This AC adapter is required if there are not any EnergyBars connected to the system. Power strips with transient suppression circuitry are best and can prevent power surges from damaging the AquaController Apex. Coil up all power cords to reduce the amount radiate electrical noise. This optional AC adapter can be plugged into a UPS so that the Apex base module will remain powered during a power outage. The absence of power on the EnergyBars can be sensed so that audible alarms and/or alarm emails can be sent.

In the event of a power outage the internal rechargeable battery will maintain the internal state of the clock and allow for the resumption of control of the aquarium as soon as power returns. After power is returned, all controlled devices will be refreshed to the correct on/off state within the Repeat Interval. The default interval is 5 minutes. See section Repeat Interval page 7 for more details on modifying the Repeat Interval.

AquaBus Modules

The AquaBus modules are all plug and play and are automatically configured when installed in the system. The total AquaBus cable length should be less than 200', and AquaBus modules can be installed in order.

NOTE: Never plug AquaBus compatible accessories into a PC's USB connector. Also PC usb equipment into the any AquaBus connector. Damage to either the AquaBus or the USB peripheral will likely occur. This user abuse is not covered under warranty.

Apex Display Module

The display module is an AquaBus plug and play meaning that it simply needs to be plugged into any of the AquaBus connectors, and it will be automatically recognized and configured. The display module has 5 directional keys, and 2 mode specific function keys (left function LF and right function RF). Typically LF is used to exit or cancel a menu selection, and RF is used to confirm (OK or Save) a configuration change. The test above the LF and RF keys indicates the current function.

The Display module should be mounted in a location that has little chance of getting. Be sure to have drip loops in AquaBus cable. The number one reason for controller failures is water damage. Without the drip loops in the cables water can run down the cord, and directly enter the display module or the Apex base module.

At least one display modules must be installed on the Apex system so that the controller can be configured, and to allow easy access to all of the monitored conditions. Additional display modules can be added so that remote tanks or equipment can have a display present.

EnergyBar 8

The EB8 should be screwed onto a wall or cabinet in a dry location so that water damage is not possible. It is recommended that you follow these guidelines:

1. Mount the EB8 above the water line of your tank.
2. Be sure to have drip loops on all cords and AquaBus cables plugged into the EB8.
3. Plug the EB8 into a Ground Fault Interrupter Circuit (GFI/C).

NOTE: Never plug AquaBus compatible accessories into a PC's USB connector. Also PC usb equipment into the any AquaBus connector. Damage to either the AquaBus or the USB peripheral will likely occur. This user abuse is not covered under warranty.

The EB8 has 6 AquaBus connector to make connecting AquaBus accessories easy. The EnergyBar AquaBus cable connects to the Apex base module. There are no ordering requirements on how the AquaBus accessories should be connected. The AquaBus modules can be daisy-chained or connected in a star type configuration.

When a new EnergyBar (EB8) is first plugged into the system, it will be automatically recognized and configured. The first EB8 installed into the system is installed at AquaBus address 3 and 8 outlets are created. The 8 outlets names are: Light1_3_1, Light2_3_2, Pump1_3_3, Pump2_3_4, Heater_3_5, Chiller_3_6, CO2_3_7, Ozone_3_8. The numbers (X,Y) at the end of the outlet name refer to the AquaBus address (X) and the outlet number (Y).

Note that the Apex/Apex Lite base module has following built-in outlets: SndAlm_I6, SndWtr_I7, FmtAlm_I5. The Apex system also has the 4 variable speed port outlets as well: VarSpd_I1, VarSpd_I2, VarSpd_I3, VarSpd_I4. These 3 or 7 outlets are built into the Apex base module and are not used to control any EB8 outlet.

Direct Connect Installation

The direct connect boxes are not plug and plug so they must be manually added to the Apex base modules configuration. On the web pages this is done in the Configuration:Module setup window or in the setup->outlet setup->add outlet menu of the Apex display. Be sure to make the control address setting of the direct connect box match the control address configure in the Apex Base module. See the instructions included with the DC4, DC4HD, DC8, or lunar simulator for instructions on how to set the module's control address.

Ethernet Installation

The AquaController Apex has an embedded 10/100 RJ45 Ethernet connector. A CAT 5E or CAT 6 cable should be used to connect the AquaController to an Ethernet switch or router. By default DHCP is enabled so installation in your network is quite easy. To install simply connect the included CAT 5E to the RJ45 Ethernet connector of the Apex base module, and the other end to an RJ45 port of your router. With the Ethernet cable installed both the green and yellow LEDs should be lit to indicate a good physical Ethernet connection.

If DHCP is enabled the network address settings will be automatically configured. To access the AquaController, put

<http://apex>

in your web browser, and you should immediately go the Apex's login screen. The default login is 'admin', and the password is '1234'.

If DHCP is disabled in the AquaController then following are the default network configuration settings:

Configuration Setting	Default Value
-----------------------	---------------

IP Address	192.168.1.50
Netmask	255.255.255.0
Gateway Address	192.168.1.1
Primary DNS	192.168.1.1
Alt DNS	192.168.1.1

NOTE: If the Apex web server is going to be accessed from the Internet it is highly recommended that a static local IP address is used (i.e. shut off DHCP and to manually configure the Apex's IP address).

It is quite likely that the defaults need to be modified to match your network settings. The network setup menu is located in the Setup->Net Setup menu. First you need to get the settings for your local network – you can do this by bringing up a command shell on your PC (type cmd in the start->run window of your PC). In the cmd shell type 'ipconfig /all' – This will display your internal IP address, netmask, default gateway, and dns server. Follow the steps below to configure the Apex's Ethernet port

1. Connect the Ethernet cable between the AquaController's Ethernet port and your router/hub/switch's Ethernet port. If the connection is good both the green and yellow LEDs on the AquaController's Ethernet connector should light.
2. Enter the netmask, default gateway, and dns server into the AquaController's network setup menus. This information is entered in the setup->net setup menu on the Apex. The IP address should be unique and different than your PC's – most likely you'll only change the last 3 digits of the address. For example if your computer's IP address is 192.168.1.101, then set the AquaController's IP address to 192.168.1.50.
3. Power cycle or restart (setup->netsetup->restart) the AquaController.
4. The controller is accessed through your internet browser by typing in the IP address of the controller in the address field of your browser. In the above example you would use 192.168.1.50.

Once that works then you can configure your router so that the AquaController can be accessed from the internet. Follow these steps:

1. Configure your router so that WAN side port 80 tcp requests are sent to the AquaController's IP address on port 80 (External port is 80, internal port is 80), and the internal IP address is the AquaController's). This configuration is usually done in the router's virtual server setup menu, port forwarding, or the UPnP section. Consult the routers manual for details. Note that some routers (Linksys) have global enables for UPnP or port forwarding, so be sure to turn this on or your router will not forward port 80 to the AquaController. A good resource to use to setup your router's port forwarding is www.portforward.com. This website has instructions on setting up portforwarding for many different types of routers.
2. Change the administrator user name and password of the AquaController. See setup->net setup on the controller.
3. To access the controller from the internet you need to know your WAN IP address; the WAN IP address can be found by going to www.whatsmyip.com. This is the IP address that will be entered into the address field of your browser when trying to access the controller from the internet. If your internet connection has dynamic IP address, then sign up for a free account at www.dyndns.org and following the installation instructions. The dyndns account will allow access to your controller using a consistent DNS name even though the IP address may change. Note that some routers (DLink for example), have built-in support for dyndns accounts so no client PC software is required.

Note: Some ISPs block incoming port 80 requests, so you will have to use a different external port number. In this case you would configure your router to route a different incoming port like 4567 (or any other 4 digit number) to port 80 of the AquaController's IP address. If this is the case in your router's port forwarding, or UPnP section configure the external port would be 4567, internal port 80, and the internal IP address of the

AquaController. If your isp blocks port 80 then you would need to enter the address as <http://123.45.67.111:4567> - substitute your internet IP address for 123.45.67.111.

Email Setup

We recommend that you get web browser access working to the Apex base module first before you attempt to setup email. The Ethernet port must be properly configured or email alarms will not work. It is easiest to setup up all of the required email fields from the Apex's Configuration: Network Setup web page, but it can also be setup in the Apex's display setup->net setup-> email setup menu as well.

1. Set up the From, and To email addresses in. The email address must be valid or the smtp server may reject the email.
2. Enter the smtp server (you will need to get this server from your ISP) into the setup->net setup->email setup->smtp server.
3. Enter the smtp server port. The default is port 25 and in most cases this will not need to be changed.
4. Try a test email - if it does work follow the debug steps at the end of this email.
5. Enter the conditions which will cause an email alarm in the EmailAlm_15 outlet name. Something like:

```
Set OFF
If Temp > 85.0 Then ON
If Temp < 75.0 Then ON
If pH > 8.50 Then ON
If pH < 7.80 Then ON
```

Please see section on alarms on page 36 for instructions more complete instructions alarm statements.

Email Debug

If emails are not working follow these steps to debug:

1. Telnet into the AquaController. In the start -> run box of your PC type 'telnet 192.168.1.50' or whatever the IP address of your AquaController is:
2. Login to the AquaController, using the controller's login and password (default login is 'admin', and the password is '1234'). Once logged in via telnet you should see the 'AquaController>' prompt each time you press the enter key.
3. At the AquaController prompt type:

```
cons
1 maild
mail
```

If you don't understand the debug messages please email the log to support@neptunesys.com, and we'll help you determine what is wrong.

Audible Alarm Setup

There are two audible alarms SndAlm and WrnAlm available in the Apex system. Each can be configured independently and when activated they can initiate different warning tones. The alarm and warning sound type are setup in the Setup->Sound Setup display menu. The various alarm sounds can be heard by scrolling through the list of sound names, and pressing the select button when the desired one is found.

The Apex Display will play the alarm or warning tone when the SndAlm or WrnAlm outlet is in the on state. A sample Alarm or Warning program would be something like this:

```
Set OFF
If Temp > 85.0 Then ON
If Temp < 75.0 Then ON
If pH > 8.50 Then ON
If pH < 7.80 Then ON
```

Please see Chapter Outlet Configuration on page 25 for instructions on how to enter these program statements into the controller.

3. Menu Overview

The options and menus in the controller may seem overwhelming at first, but after a little practice you will find that they are arranged in a logical and consistent manner.

All menus and sub-menus follow the same user interface. The Up and Down buttons move the arrow cursor up and down. The Select button activates the current menu entry pointed to by the cursor. The activation will execute a command, bring up another menu, or exit the current menu. Common to all menus is the exit button (left function). When exit is pressed, the current sub-menu pops up and control is returned to the previous (next higher) level menu.

To make it easier to enter data into the AquaController Apex, all of the buttons have an auto repeat function. When any button is pressed for greater than 3/4 of a second, the current action begins to repeat. If the button is pressed an additional 1 second, the auto repeat rate increases.

Home Display

On the Apex system there are 4 customizable home screens that can be independently configured. On each home screen there are five main sections. The first is the date and time. The next two sections are the 1 to 4 probes (pH, ORP, temperature, and electrical current) which may be displayed. The final two sections are for configuring the 8 or 16 outlet status icons. The home page number is represented by 1 to 4 tick marks in the top left hand corner of the display. During most of the AquaController Apex operation this will be the active display. If no input occurs (button selection) the LCD screen will automatically return to this display. Many of the menu navigation menus have a Home key so that this display can be quickly returned to.

The outlet status can be either an icon if it is in automatic mode, or On/Off if the outlet has been manually turned on or off. Manual and Automatic mode are described in section 'Control and Status' on page 16. The 'UNK' character indicates that the state of the controlled devices is undefined. The undefined state can be entered in two ways.

1. The controller has not yet evaluated the outlet statements name.
2. The program statements create a circular loop, and the controller state is not defined.
3. None of the program statements has ever been true.

Pressing the Down button while the Run Display is active will initiate a Feed Cycle. During the Feed Cycle the display will show a countdown of the number of seconds remaining. The Run Display is resumed following the completion of the Feed Cycle. The cancel button (right function) can be used to end the Feed Cycle early. To return to the menus and leave the feed cycle running press the exit button (left function). See section 'Feed Cycle' on page 16 for more details.

To exit the Home Display and enter the root level menu press the Select button.

Configuration of the Home Display is done in the setup->Display Setup -> Home Display menu on the Apex display module user interface. First select which home display page you would like to modify.

Once the desired home page is selected to be configured you are able to select in the first field whether or not the time/date should be enabled/disabled.

The next 2 sections allow for which probes to be displayed on lines 2 and 3 of the display. The final sections determine which outlets you would like to have displayed on this home page. You have the option of disabling a particular display line if you desire less information to be displayed.

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Control and Status

Feed Cycle

A special case of manual mode of operation is the Feed Cycle. This option allows the user to shut down certain pumps, powerheads, etc. for a fixed period of time for the purpose of feeding the tank. To start a Feed Cycle select the Feed Cycle entry in the Manual Control menu. When this mode is entered, the Feed Cycle controlled outlets are temporarily forced into the programmed state. The display shows a countdown of the number of seconds remaining. When the count reaches zero, the Feed Cycle controlled modules return to normal operation. The Feed Cycle can be interrupted early by pressing the Cancel button (right function key). The exit button will leave the feed cycle running and return to the menus. See section 'Feed Cycle' on page 35 for instructions on how to program an Outlet to use a Feed Cycle and section Feed Interval on page 27 on how to change the Feed Cycle duration.

To reduce the number of button presses required to initiate a Feed Cycle, a shortcut has been added to the Home display. When the Home Display is active (see section 'Home Display' on page 15), the Down button can be used to initiate a Feed Cycle, and then press the up or down buttons select which feed cycle (A to D) to start.

Manual Control

The manual timer menu allows you make outlet manually on, manually off, or in automatic mode. When in automatic mode the outlet will follow the program statements. When the display is on the home screen the outlet status will be either ON, OFF, or the icon chosen for that outlet. See the Home display configuration section for instructions on how to customize which outlets and probes are displayed on the home screen.

Feed Cancel

This menu entry allows for a feed cycle to be terminated early. Just press select with the arrow next to the Feed Cancel to cancel any currently running feed cycle.

Module Status

This menu will list all the currently installed AquaBus modules in the system. The fields displayed include the module name, the internal AquaBus address of the module, and firmware revision of the module, and its current hardware status.

Display Lock

The display lock allows the menu entries to be password protected so that unauthorized users cannot modify the controller's configuration. When the display lock is on, the user is prompted for a password whenever the home display is exited. The default password is lower case 'xyz'. The display password can be changed in the setup -> display setup menu.

Data Logging

Data logging is a powerful feature which enables accurate tracking and recording of the conditions in the aquarium. There are many possible uses for the data, some of which include analysis to help find cause and effect relationships, trends which may foreshadow potential problems, and monitor the tank conditions necessary to induce fish or coral spawning. The Apex's flash memory is used to hold the datalogs, and they are retained between reboots and power cycles. Up to 1 years worth of datalogs can be held in this internal memory. The exact amount varies depending on the how frequently data log samples are taken. When the datalog memory is full the oldest datalog entries are erased to make room for new datalogs.

Graph Data Log

The Graph menu allows you to graph the contents of the data log on the LCD screen. The display data log menu displays the temperature, pH, and ORP of any of the connected probes as well as the current from any of the

attached EnergyBars.

The initial display shows the graph of the first probe (typically base unit's temperature). The up and down arrows are used to scroll forward and backwards respectively through the probes. The left and right are used to advance backwards and forwards in time a day at a time. To exit the graph display press the select button or the exit (left function) button.

Power Fail Log

The power fail menu allows you to display the last power failure and reset the power failure log.

Power Log

Selecting the power log menu display the last power failure time/date and the power restored time/date of the last power interruption. If 'none' is in the power failed entry then no power failure has occurred.

Reset Power Log

Activating this menu entry will reset the power failure and power restored time/date entries to 'None'.

Log Interval

The Log Interval menu allows you to set how often the AquaController Apex logs a pH, ORP, or temperature measurement to the data log. To modify select Log Interval and use the Up and Down buttons to advance to the desired interval value. When displayed press the Select button. Ten minutes is the default setting for log interval.

Setup

Outlet and Profile Setup

The outlet setup and programming instructions are described in Outlet Configuration chapter 5 on page 25

Module Setup

This menu allows for the naming, manual additional, and deletion of modules.

Module Name

This menu allows for the modules name to be set. Just select the module to be renamed, and edit its name.

Update Module

This menu allows for the modules firmware in the module to be updated. While the firmware in the module is being updated the buttons on the display will not work. Also note when an EnergyBar's firmware is updated all of the outlets will revert to their fallback state. Module updates take between 10 and 60 seconds depending on the module. Do not interrupt power while a module update is in progress.

Add Module

The add module menu allows for a direct connect, lunar simulator, or AquaSurf to be added to the system. Select the appropriate module type and its control starting address, and then press the save button (right function), and the module will be added to the system.

Delete Module

The delete module allows for the deletion of an AquaBus module that has been removed from the system.

Clock Setup

The tank clock keeps track of the time in the tank and is the main clock used by the outlet program to turn off or on the desired modules. The clock can be set by following the directions listed below:

1. Go to the Setup/Clock Setup.
2. Select either Set Tank Time from the menu depending on which clock needs to be set.
3. Use the Up and Down buttons to adjust the selected field to the desired value. When the value is correct use the Select button to advance to the next field. Repeat until all time values are entered.

Leap Seconds

The Leap Seconds allows the user to fine tune the accuracy of the clocks used in the AquaController Apex. The number programmed into the AquaController Apex indicates how many seconds to adjust the internal clock per day. For example if the clock is gaining 1.5 seconds per day, a value of -1.5 would be entered to offset this inaccuracy. The AquaController Apex uses this value to slow its time down by 1.5 seconds each day. To modify this entry, select Leap Seconds and use the Up and Down buttons to scroll to the desired Leap Seconds value. When displayed press the Select button.

Temperature Setup

Temperature setup and probe installation are described in section 'Temperature Probe Installation' on page 21 and 'Temperature Calibration' on page 22. Additional temperature probes can be added to the system with our PM1 expansion module.

pH Setup

pH setup and probe installation are described in section 'pH Probe Installation' on page 21 and 'pH Calibration' on page 23. Additional pH probes can be added to the system with our PM1 expansion module.

ORP Setup

ORP setup and probe installation are described in section 'ORP Probe Installation' on page 22 and 'ORP Calibration' on page 23. Note: The Apex Lite base module does not include an ORP input connector. The ORP connector is only present on the full Apex base module. Additional ORP probes can be added to the system with our PM1 expansion module.

Net Setup

This menu allows for the setup of all configuration settings associated with the Ethernet port.

IP Address

The default IP address is 192.168.1.50. To change the address press the select button advance to the next 3 digit address field. The up button increments the numeric field, and the down button decrements it.

Netmask

The default netmask is 255.255.255.0 (Class C network). To change the netmask press the select advance to the next 3 digit mask field. The up button increments the numeric field, and the down button decrements it.

Gateway Address

The default gateway address is 192.168.1.1. If access outside your local network is required then this address should be set to gateway IP address (typically your cable or DSL modem). To change the address press the select button advance to the next 3 digit address field. The up button increments the numeric field, and the down button decrements it.

Admin Login/Password

The default admin login and password is 'admin' and '1234' respectively. This menu allows for the telnet, and web pages to be login and password protected. If the controller is accessible from the internet, it is highly recommended that the login and password fields are set to secure values.

DNS IP Address/Alternate DNS IP Address

The DNS IP address must be setup if the email alarm features of the controller are desired. Consult you ISP for the correct DNS and alternate DNS IP address, and enter into this field. To change the address press the select button advance to the next 3 digit address field. The up button increments the numeric field, and the down button decrements it.

Restart

Any changes to the network fields do not take place until the controller is restarted. This menu entry allows the controller to be reboot without having to power cycle it.

Display Password

This menu allows for the changing of the password used if the display lock feature is turned on. The default password is lower case 'syz'. The space character is used to terminate the entry of password if less than a four character entry is desired.

Init Memory

Init All will reset all the configuration settings back to the factory default. This includes the AquaBus device table, outlet configuration, and profile configuration.

Initial Outlets will reset all the outlet configuration back to the factory default.

Init AquaBus Dev will reset the initial AquaBus module table back to the factory default settings.

Initialize Profiles will reset the profile settings back to the factory default settings.

Self Test

The Self Test feature of the AquaController Apex performs a short diagnostic on the major internal components in the base unit. If the Self Test is selected and the unit is operating correctly, a "passed" message is displayed on the screen. The other information displayed indicates the date and revision of the AquaController Apex firmware as well as the controller's serial number.

4. Probe Installation and Calibration

Probe Installation

Temperature Probe Installation

Before installing the temperature probe in the aquarium, the probe should be rinsed under tap water to make sure that it is clean. Route the cable from the location of the AquaController Apex to the aquarium or the sump. It should be installed in a vertical position where there is adequate water flow.

The AquaController Apex must be informed that a temperature probe has been installed. To enable the temperature probe go to the Setup/Temp Setup menu and select 'Temp On'

To remove Temperature from the AquaController Apex display, follow the above procedure and instead select Temp Off.

If a probe expansion box which has temperature probes is used with the controller, then the additional temperature probe are also enabled in the above menu. The first probe expansion boxes temperature probe is name TMPA, and second expansion box's temperature probe is TMPB, and so on.

pH Probe Installation

The rubber cap on the end of the probe should be removed before it can be used. Once the protective cap has been removed the probe must be kept wet at all times. Failure to do so will result in damage to the probe. If the probe is to be stored for some period of time, place pH=4.0 calibration solution into the protective cap before placing it on the end of the probe.

Before installing the probe in the aquarium, it should be rinsed of any white residue under warm tap water and then installed in a vertical position in the aquarium or sump where there is adequate water flow.

Route the coax cable to the location of the AquaController Apex. Attach the BNC connector on the cable to the pH BNC input of the AquaController Apex. Refer to figure 1 for the position of the pH BNC input on the AquaController Apex. Turn the BNC connector 1/4 turn clockwise to lock it firmly into place.

If a second pH probe is to be used with the Apex, enable it in the pH setup menu. The second pH probe plugs into the AquaController's ORP connector. Note that only an ORP probe or a second pH probe can be used at the same time (not both).

The AquaController Apex must be informed that a pH probe has been installed. This is accomplished by the following procedure:

1. Go to the Setup/pH Setup menu.
2. Select pH On
3. Go to the Run menu at the top level. The pH label and its current reading should be on the display.

To remove pH from the AquaController Apex display, follow the above procedure and instead select pH Off in step 2.

If a probe expansion box which has pH probes is used with the controller, then the pH probes are also enabled in the above menu. The first probe expansion boxes pH probe is name pH1A1, the second pH probe of the same expansion box is pH1A2, and second expansion box's pH probe is pH1B1, and so on.

ORP Probe Installation

Note: The Apex Lite base module does not include an ORP input connector. The ORP connector is only present on the full Apex base module.

The plastic cap on the end of the probe should be removed before it can be used. Once the protective cap has been removed the probe must be kept wet at all times. Failure to do so will result in damage to the probe. If the probe is to be stored for some period of time, place pH=4.0 calibration solution into the protective cap before placing it on the end of the probe.

Before installing in the aquarium the probe should be rinsed of any white residue under warm tap water and then installed in a vertical position in the aquarium or sump where there is adequate water flow.

Route the coax cable to the location of the AquaController Apex. Attach the BNC connector on the cable to the ORP BNC input of the AquaController Apex. Refer to figure 1 for the position of the ORP BNC input on the AquaController Apex. Turn the BNC connector 1/4 turn clockwise to lock it firmly into place.

The AquaController Apex must be informed that an ORP probe has been installed. This is accomplished by following this procedure:

1. Go to the Setup/ORP Setup menu.
2. Select ORP On
3. Go to the Run menu at the top level. The ORP label and its current reading should be on the display.

To remove ORP from the AquaController Apex display, follow the above procedure and instead select ORP Off in step 2.

If a probe expansion box which has ORP probes is used with the controller, then the additional ORP probes are also enabled in the above menu. The first probe expansion boxes ORP probe is name ORPA, and second expansion box's ORP probe is ORPB, and so on.

Probe Calibration

Calibration of the AquaController Apex is quite simple, and should be checked at regular maintenance intervals to insure accurate operation.

Temperature Calibration

It is not necessary to calibrate the temperature probe of the AquaController Apex. It has been properly calibrated at the factory to maintain accurate temperature readings for the lifetime of the probe. However, it is possible to make small adjustments to the displayed temperature so that it may be more closely correlated with another temperature monitor. The following procedure should be used:

1. Note the amount that the temperature needs to be adjusted either up or down. For example, if the AquaController Apex temperature reads 77.4 °F and the reference thermometer reads 77.0 °F, an offset of -0.4 °F should be added to the AquaController Apex temperature.
2. Go to the Setup/Temp Setup/Temp Calibration menu.
3. Use the Up/Down buttons to enter the desired offset, which is -0.4°F in the above example.

When finished push the Select button.

4. Go to the Run menu and now the temperature should match the reference. If not, go back to step 1 and try again.

pH Calibration

Because of the variability in pH probes and the fact that they change over time, it is best to calibrate the AquaController Apex pH circuitry. A two point calibration scheme is used to obtain the good results. For the most accurate results it is best to use pH 7.00 and 10.00 solutions for salt water and pH 4.00 and 7.00 for fresh water.

The following procedure outlines the steps necessary:

1. Go to the SetuppH Setup menu. Enable or disable temperature compensation depending upon your requirements.
2. Select the pH Calibrate menu.
3. Use the Up and Down buttons to select the lowest valued calibration solution. In order for the calibration procedure to work correctly the low valued calibration must be used first.
4. Place the pH probe into lowest valued calibration solution. Wait for the numbers on the bottom of the LCD screen to stop changing. It does not matter what value is displayed only that it is not changing. When the display stops changing press the select button.
5. Rinse the probe in room temperature tap water.
6. Use the Up and Down buttons to select the high valued calibration solution. Press the select button when the correct value is displayed.
7. Place the pH probe into high valued calibration solution. Wait for the numbers on the bottom of the LCD screen to stop changing. When the display stops changing press the select button.
8. The pH probe should now be properly calibrated.

ORP Calibration

Note: The Apex Lite base module does not include an ORP input connector. The ORP connector is only present on the full Apex base module.

It is not necessary to calibrate the ORP probe of the AquaController Apex. It has been properly calibrated at the factory to maintain accurate ORP readings for the lifetime of the controller. However, it is possible to calibrate the probe if so desired. Quinhydrone, pH 4.00 and pH 7.00 calibration solutions are required for the calibration. The following procedure should be used to calibrate the ORP:

1. Create a saturated solution of Quinhydrone and pH 7.00 calibration solution (Add Quinhydrone powder to the 7.00 calibration solution until it no longer dissolves. Adding too much powder does not hurt; it only wastes the Quinhydrone.
2. Select SetupORP SetupORP Calibrate from the AquaController Apex's menus.
3. Place the ORP probe into the Quin-7.00 solution. Wait for the numbers on the bottom of the LCD screen to stop changing. It does not matter what value is displayed only that it is not changing. When the display stops changing press the select button.
4. Create a saturated solution of Quinhydrone and pH 4.00 calibration solution.
5. Place the ORP probe into the Quin-4.00 solution. Wait for the numbers on the bottom of the LCD screen to stop changing. It does not matter what value is displayed only that it is not changing. When the display stops changing press the select button.
6. The ORP probe is now calibrated.

5. Configuring the AquaController Apex

The AquaController Apex comes equipped with a simple yet powerful programming language which enables it to perform the normal aquarium control tasks as well as many tasks which are impossible to perform on a conventional controller. All program statements can be entered through the display module or by using a standard web browser. In many cases the programming wizards can be used to set up the control functionality of the outlet. Many new users find the wizards easier to initially configure the controller as no knowledge of the programming language is required.

The program and configuration information input are stored in the AquaController Apex's non-volatile memory. Power failures do not affect the contents of this memory.

There are two ways to connect control equipment to the Apex base module. Legacy equipment like the DirectConnect 8, DirectConnect 4, or Lunar Simulator are daisy-chained using a telephone cord like interface through the Apex's control port. AquaBus control equipment (EnergyBars) is connected with AquaBus cables (USB type A connectors).

NOTE: Never plug AquaBus compatible accessories into a PC's USB connector. Also PC usb equipment into the any AquaBus connector. Damage to either the AquaBus or the USB peripheral will likely occur. This user abuse is not covered under warranty.

All AquaBus modules are plug and play, and are automatically detected and configured by the Apex base module. Legacy control equipment connected by the control port must be manually added and configured by the user (see the Setup -> Module setup).

When a new EnergyBar (EB8) is first plugged into the system, it will be automatically recognized and configured. The first EB8 installed into the system is installed at AquaBus address 3 and 8 outlets are created. The 8 outlets names are: Light1_3_1, Light2_3_2, Pump1_3_3, Pump2_3_4, Heater_3_5, Chiller_3_6, CO2_3_7, Ozone_3_8. The numbers (X,Y) at the end of the outlet name refer to the AquaBus address (X) and the outlet number (Y).

When Direct Connect modules (DC8, DC4HD) are manually added or EnergyBars are plugged into the system, default programming statements are automatically generated for all of the controlled outlets. Most users will only have to make minor modifications to these standard configurations to control and monitor their aquatic system.

Note that the Apex/Apex Lite base module has following built-in 'outlets': SndAlm_16, SndWrm_17, EmailAlm_15. The Apex system also has the 4 variable speed port outlets as well: VarSpd_11, VarSpd_12, VarSpd_13, VarSpd_14. These 3 or 7 outlets are built into the Apex base module and are not used to control any EB8 outlet.

Outlet Configuration

All outlet configuration can be done through the menus on the display module or through the web interface. Either interface may be used at anytime during the configuration process. It is really up to the user as to decide which interface is easier to use.

Modify Outlet

This menu allows for the modification of the following items:

Outlet's Name: 11 character named outlets make it much easier to remember what each outlet controls.

- Icon: Allows for the selection of the icon that is to be displayed on the home screen of the Apex display module.
- Addr: The address field is only configurable on control port devices (DC8). The address setting should match the address setting should match the address switch settings (Letter/Number) of the direct connect device.
- Program Type: The program type field specifies whether or not to use a wizard to set up the control functionality of the outlet or to use AquaController's programming language. New users should probably use the wizard as it

The program types available are:

- Advanced: This program type allows for the outlet to be configured using the AquaController's programming language. Use this mode for the most flexibility in controlling the outlet.
- Light: The light program type is used for simple timed operations typically used on lights.
- Pump/The pump program type is used for repetitive on/off operations typically used for wavemaker functionality.
- Heater: The heater program type is used to control the heating element used to raise the temperature of the aquarium.
- Chiller: The chiller program type is used to control the cooling element used to lower the temperature of the aquarium.
- pH Control: The pH control program type is used raise or lower the pH of the aquarium.
- ORP Control: The ORP control program type is used raise or lower the ORP of the aquarium.

Program Outlet

There are two different ways to configure an outlet. For very simple menu driven configuration new users should use the wizard program type. To perform more sophisticated control operations use the Advanced program type. The programming type is set in the Setup->Outlet Setup->Modify Outlet Menu.

If program type has been set to Light, Pump, Heater, Chiller, pH control, or ORP control, then when the outlet program is modified a simple menu with editable on/off times or temperatures is displayed. These menus are very intuitive and a brief explanation of the fields is given below.

Light Wizard

Fallback	When used with an EnergyBar the outlet is given the fallback state if communication between the Apex base module, and the EnergyBar fails.
On Time	The time to turn on the light in 24 hour format. (HHMM)
Off Time	The time to turn off the light in 24 hour format. (HHMM)
Temp Probe	Temperature probe name used to shutdown the light in case of an over temperature alarm.
Off Temp	Temperature at which to shut off the light
Hysteresis	The amount of time to leave the light off in the event of an over temperature condition.

Pump Wizard

Fallback	When used with an EnergyBar the outlet is given the fallback state if communication between the Apex base module and the EnergyBar fails.
Off Time	The initial off time of the pump in MMSS format.
On Time	The on time of the pump in MMSS format.
Off Time	The final off time of the pump in MMSS format.
Feed	Sets which feed cycle [A-D] will shutdown the pump.

Feed Delay	The amount of time to wait after a feed cycle is over before a pump is returned to its normal operating mode.
------------	---

Heater Wizard

Fallback	When used with an EnergyBar the outlet is given the fallback state if communication between the Apex base module and the EnergyBar fails.
Temp Probe	Temperature probe name used to control the temperature of the tank.
On Temp	The temperature to turn on the heater. Should be less than the off temperature.
Off Time	The temperature to shut off the heater. Should be greater than the on temperature.

Chiller Wizard

Fallback	When used with an EnergyBar the outlet is given the fallback state if communication between the Apex base module and the EnergyBar fails.
Temp Probe	Temperature probe name used to control the temperature of the tank.
On Temp	The temperature to turn on the chiller. Should be greater than the off temperature.
Off Time	The temperature to shut off the chiller. Should be less than the on temperature.

ORP or pH Wizard

Fallback	When used with an EnergyBar the outlet is given the fallback state if communication between the Apex base module and the EnergyBar fails.
Probe	Probe name used to control the pH or ORP of the tank.
High Value	The high value to turn on or turn off the outlet
Low Value	The low value to turn on or turn off the outlet
On When	If set to 'Low' then the outlet will turn on when the probe reading is below the low value, and shut off when it exceeds the high value. If set to 'High' then the outlet will turn on when the probe reading is above the high value, and shut off when it is below the low value.

Add/Delete Outlet

These menus allow for the manual addition of a control port device. Note that it is not possible to delete the outlet of an AquaBus module (the whole module must instead be deleted). To quickly add multiple outlets of a direct connect device see the Setup->Module setup menu.

Repeat Interval

The Repeat Interval defines how often the AquaController Apex retransmits commands to the legacy control port modules. The commands are repeated on a periodic basis to ensure that all of the control modules are in the correct state. The default setting for Repeat Interval is 5 minutes and should not have to be changed by you:

Feed Interval

The Feed Interval menu allows you to change the length of time in minutes of any of the four feed or maintenance cycles. Individual outlets can be configured to be configured to turned on or off when the feed cycle is activated. See the description of the 'If Feed' statement in the language reference for a complete description. A feed cycle is initiated by either pressing the down button on the Home screen, or by selecting the Feed Cycle in

the Control & Status menu.

Program Outlet

There are two different ways to configure an outlet. For very simple menu driven configuration use the wizard program type. To perform more sophisticated control operations use the Advanced program type. The programming type is set in the Setup->Outlet Setup->Modify Outlet Menu.

Using the Wizard to program The AquaController Apex uses a simple programming language to control the external modules.

The AquaController Apex uses a simple programming language to control the external modules. The program statements are input through the seven button interface. The procedure below illustrates how to input a typical program statement: (the program type must be advanced which is set in the Setup/Outlet Setup/Outlet Type menu) through the buttons on the keypad.

1. Go to the Setup/Outlet Setup/Outlet Program menu.
2. Select the outlet whose configuration you wish to modify.
3. Use the Up and Down buttons to choose which program statement you wish to edit. Or you can use the left and right buttons to change the edit mode. The left and right buttons will cycle through the following: Edit Statement, Insert After, Insert Before, and Delete. When the select button is pressed the appropriate action will be taken on that statement. If a statement is edited or added then proceed to step 4.
4. The Up and Down buttons to scroll between all the possible tokens at the current cursor position of the program statement. Pressing left or right allows you to go forward or backward through the program statement one token at a time. When the program statements is correct press the OK button (right function). The edit or add statement can be canceled by pressing the Exit button (left function).
5. Continue to input the control statements until finished by jumping back to step 3. When the configuration of the outlet is complete press the save button (right function) to permanently save the statement. Pressing the exit button (left function) will exit the program editor without saving the changes for the outlet.

Temperature Controller Setup

For the successful aquarium, it is very important to maintain an accurate and stable temperature throughout the day. Large fluctuations in temperature can result in the loss of aquatic life. The AquaController Apex is capable of controlling the temperature very accurately (+/- .3 °F), since it continuously monitors the environment.

Depending on the external conditions both a heater and chiller may be necessary to maintain a stable temperature for the aquarium inhabitants. The AquaController Apex is capable of controlling a heater, a chiller, or both.

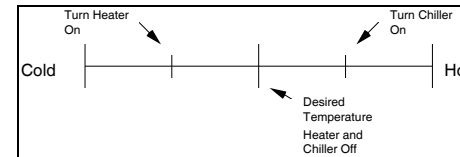


Figure 5: Temperature Scale

The above figure illustrates the mechanism which is used to maintain the temperature. When the temperature drops below a preset value, the heater is turned on and when the temperature rises to the desired temperature, the heater is shut off. Likewise when the temperature exceeds the preset high value, the chiller is turned on and when the temperature falls to the desired temperature, the chiller is shut off.

Temperature Control Program

Fixed Temperature

Suppose that the desired temperature of the aquarium is 77 °F. The heater should be enabled if the temperature falls below 76.7 °F, and disabled when the aquarium reaches the desired 77 °F. Likewise the chiller should be enabled if the temperature rises above 77.3 °F, and disabled when the temperature reaches the desired 77 °F. It is recommended that the high and low set points be at least 0.3°F from the desired temperature.

For the heater control described above the following code produces the desired result for a heater outlet:

```

Fallback Off
If Temp < 76.7 Then ON
If Temp > 77.0 Then OFF
    
```

For the chiller control described above the following code produces the desired result for a chiller outlet:

```

Fallback Off
If Temp > 77.3 Then ON
If Temp < 77.0 Then OFF
    
```

If the aquarium only has a heater, it is necessary to only enter the heater portion of the control program shown above. Conversely, if only a chiller is to be used, then the chiller portion of the control is all that is necessary to enter into the AquaController Apex.

If a probe expansion box is used, the first expansion temperature probe is referenced as TmpA, and the second expansion box's temperature probe is referenced as TmpB, and so on.

Seasonal Temperature Variation

One of the AquaController Apex's more advanced features is its ability to simulate the varying temperatures during the seasons of the year. The following table lists the default temperatures for the first of each month. On days other than the first the temperatures are interpolated with the current and next month values.

Month	Temp (°F)
January	76.0
February	75.0
March	76.0
April	76.0
May	76.5
June	77.5
July	78.5
August	80.5
September	78.5
October	77.5
November	76.5

December	76.0
----------	------

To illustrate how to use this advanced feature for heater control, refer to the following program:

```

Fallback Off
If Temp < RT+0.4 Then ON
If Temp > RT+0.0 Then OFF
    
```

The above statements turn the heater on if the tank temperature falls below the season temperature (RT) of the day by more than 0.4 °F and shuts the heater off when the tank temperature exceeds the season temperature (RT). For chiller control a similar program is used and is illustrated below:

```

Fallback Off
If Temp > RT+0.4 Then ON
If Temp < RT+0.0 Then OFF
    
```

The first program statement turns on the chiller (COL) when the tank temperature exceeds the seasonal temperature (RT) by 0.4 °F and shuts the heater off when the tank temperature is below the seasonal temperature (RT).

If the probe module (PM1) is used with the Apex system, the temperature probe is name TmpX_Y, where Y is the AquaBus address of the probe module. If a probe expansion box (PX1000) is used, the first expansion temperature probe is referenced as TmpA, and the second expansion box's temperature probe is referenced as TmpB, and so on.

pH Controller Setup

pH is perhaps one of the most critical parameters to maintaining a successful aquariums. Many reef aquariums which are heavily stocked with stony corals require large additions of kalkwasser on a continuous basis. The large additions of kalkwasser can result in the pH rising too high. To counter the high pH, CO₂ is injected into the aquarium. However, the pH must be monitored closely when CO₂ is injected so that the pH does not dip too low. The injection is difficult if not impossible to do adequately by hand. This task is ideally suited for the AquaController Apex, since it continuously monitors the pH and can enable /disable CO₂ injection at the appropriate times.

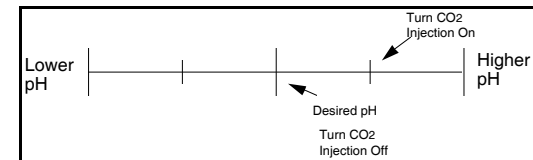


Figure 6: pH Scale

The above figure illustrates the mechanism which is used to maintain the pH. When the pH rises above a preset level the CO₂ injection is turned on, and when the pH falls to the desired value, the injection is shut off.

pH Control Program

Suppose that the desired pH of the aquarium is 8.35, and the CO2 injector should be enabled if the pH rises above 8.40. It is recommended that the high set point be at least 0.05 from the desired pH.

For the pH control described above the following code produces the desired result. The code assumes that the CO2 injector outlet:

```
Fallback Off
If pH > 8.40 Then ON
If pH < 8.35 Then OFF
```

If a second pH probe is installed into the ORP probe of the AquaController Apex, it is referred to as pH2 in the program statements. If the probe module (PM1) is used with the Apex system, the temperature probe is name pHxY, where Y is the AquaBus address of the probe module. If a probe expansion box (PX 1000) is used, the first expansion pH probe is referenced as pH1A1, and the second expansion box's pH probe is referenced as pH1B1, and so on.

ORP Controller Setup

Oxidation Reduction Potential (ORP) is a good indicator of the water quality of the aquarium. ORP is a measurement of the potential for chemical reactions in the aquarium. If it is too low the aquarium water contains many organic carbons and the water can be toxic. Ozone is a highly reactive form of oxygen which can be injected into the aquarium to reduce the amount dissolved organic carbons in the aquarium. It must be injected carefully as too much can be lethal to the aquarium inhabitants. This task can be done easily by the AquaController Apex since it continuously monitors the ORP and can enable and disable ozone injection at the appropriate times.

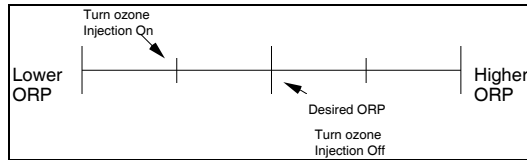


Figure 7: ORP Scale

The above figure illustrates the mechanism which is used to maintain the ORP. When the ORP falls below a preset level the ozone injection is turned on, and when the ORP rises to the desired value, the injection is shut off.

ORP Control Program

Suppose that the desired ORP of the aquarium is 375 mV, and the ozone injector should be enabled if the ORP falls below 365 mV. It is recommended that the low set point be at least 10 mV from the desired ORP.

For the ORP control described above the following code produces the desired result assuming that the ozone injector outlet name is Ozone:

```
Fallback Off
If ORP < 365 Then ON
If ORP > 375 Then OFF
```

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If the probe module (PM1) is used with the Apex system, the temperature probe is name ORPxY, where Y is the AquaBus address of the probe module. If a probe expansion box (PX 1000) is used, the first expansion ORP probe is referenced as ORPA, and the second expansion box's ORP probe is referenced as ORPB, and so on.

Timed Events Setup

The AquaController Apex can control such devices as lights, pumps, power-heads, and chemical dosing. The AquaController Apex has an internal real time clock which can be used to enable/disable many control modules throughout the day. The times programmed into the AquaController Apex are compared with the controller's clock. The timed events capability is best illustrated through several examples.

Timed Lighting

Suppose that a reef aquarium has two independent lights which need to be turn on and off at appropriate times. The first lighting system should come on at 8:30 AM and be turned off at 9:30 PM. The second lighting system should come on at 9:30 AM and be turned off at 8:30 PM.

For the lighting control described above the following code produces the desired result. It assumes that the light outlet names are Light1 and Light2. NOTE: The AquaController Apex time display is in 24 hour military format.

For outlet Light1

```
Fallback Off
Set Off
If Time 08:30 to 21:30 Then ON
```

For outlet Light2:

```
Fallback
Set Off
If Time 09:30 to 20:30 Then ON
```

Timed Pumps

The AquaController Apex can be used to simulate the tide in an aquarium. This can be accomplished by having two power heads at opposite ends of the aquarium which could be alternately turned on and off.

The following AquaController Apex code will produce this effect:

For Pump1:

```
Fallback On
If Time 00:00 to 06:00 Then ON
If Time 06:00 to 12:00 Then OFF
If Time 12:00 to 18:00 Then ON
If Time 18:00 to 00:00 Then OFF
```

For Pump2:

```
Fallback On
If Time 00:00 to 06:00 Then OFF
If Time 06:00 to 12:00 Then ON
If Time 12:00 to 18:00 Then OFF
If Time 18:00 to 00:00 Then ON
```

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This program assumes that pump 1 (Pump1) and pump 2 (Pump2) are located on opposite ends of the aquarium.

Repetitive Events

The powerful OSC (short for oscillate) statement makes these very easy to program. The first time parameter is the initial off time in minutes:seconds. The second parameter is the on time in minutes:seconds, and the 3rd parameter is the final off time. Each pump outlet will initially start in the initial off state, then go to the on state, and then to the final off state. This cycle will repeat over and over again.

Suppose that it is desired to have three power heads turn on one at a time for 5 minutes each.

The following AquaController Apex code will produce this effect:

For Pump1:

```
Fallback ON
OSC 10:00/05:00/00:00 Then ON
```

For Pump2:

```
Fallback ON
OSC 05:00/05:00/05:00 Then ON
```

For Pump3:

```
Fallback On
OSC 00:00/05:00/10:00 Then ON
```

The wave maker capability of the AquaController Apex can be used to create an alternating left to right and then right to left current in the aquarium. This type of water motion can be accomplished by placing one powerhead on the left side of the tank and one on the right side. The pump on the left is turned on for a fixed interval and then shut off. Then the pump on the right is turned on for a fixed interval and then shut off. The following program will produce this effect and assumes that the fixed interval is 20 minutes.

For Pump1:

```
Fallback On
OSC 20:00/20:00/00:00 Then ON
```

For Pump2:

```
Fallback On
OSC 00:00/20:00/20:00 Then ON
```

Seasonal Lighting Variation

One of the AquaController Apex's more advanced features is its ability to simulate the varying lengths of daylight during the seasons of the year. The following table lists the default sunrise and sunset times for the first of each month. These times are based upon a typical tropical reef at 15° north latitude. On days other than the first the sunrise and sunset times are interpolated.

Month	Sunrise	Sunset
January	7:33	18:51
February	7:37	19:07
March	7:26	19:17
April	7:06	19:21
May	6:47	19:25
June	6:39	19:34
July	6:43	19:41
August	6:52	19:38
September	6:57	19:21
October	6:58	18:59
November	7:03	18:41
December	7:17	18:38

To illustrate how to use this advanced feature, refer to the following program:

For Light1:

```
Fallback Off
If Sun 000/000 Then ON
```

For Light2:

```
Fallback Off
If Sun 060/-045 Then ON
```

The first statement turns on the first light (outlet Light1) at sunrise of the particular day and off at sunset. The second program statement turns on the second light (outlet Light2) 60 minutes after sunrise and shuts it off 45 minutes before sunset. By varying the sunrise and sunset offsets of various lights, it is possible to simulate the increasing intensity of light at sunrise and the decreasing intensity at sunset.

Simulating the Moon Cycle

One of the AquaController Apex's more advanced features is its ability to simulate the phases of the moon by simulating both the moonrise and moonset as well as varying the intensity of the light source. The AquaController Apex's moonrise and moonset times match the true lunar cycle.

On days other than the first of the month, moonrise and moonset times are interpolated.

NOTE: Just like in the real world the moonrise and moonset are approximately 50 minutes later each day. So during a new moon the moonrise is in the morning and the moonset is in the evening. Typically during a full moon the moonrise time is in the evening and the moonset time is in the morning. It is possible for the moon light to be on during the day period.

To illustrate how to use this advanced feature, refer to the following program:

```
If Moon 000/000 Then ON
```

The first statement turns on the moon light at the moonrise of the particular day and off at the moonset. If the intensity of the lunar light is to be varied throughout the course of the lunar cycle, then a Lunar Simulator with LED light should be used for the moon cycle simulation. Lunar simulators are available in 2 to 5 LED

configurations, and the correct size should be purchased depending on your tank size.

Feed Cycle or Maintenance Cycle

The AquaController Apex is capable of shutting off or turning on certain devices for a period of time and then resuming normal operation. This behavior is desirable for the main pumps and power heads in the aquarium during feed times. With the pumps shut down floating food will not be washed into the surface skimmer before the fish have had a chance to eat it. Also, it can be used to force lights, pumps, etc. on or off for a short duration maintenance event.

The AquaController Apex must be told by programming which modules should be shut off during a feed cycle. Suppose that there is one main pump and a power head in the system, and they should be shut off for 5 minutes on a user initiated feed cycle. The following program will accomplish this:

MainPump:

```
Set ON
If FeedA 005 Then OFF
```

Powerhead

```
OSC 20:00/10:00/00:00 Then ON
If FeedA 000 Then OFF
```

Programming the length of the Feed Cycle time interval is described in section Feed Interval on page 27. The letter (A through D) following the Feed keyword specifies which feed outlet to use. The number following the Feed keyword specifies the number of minutes that the outlet is to remain on/off following the completion of the feed cycle count down. In the above example Powerhead will turn back on at the end of the feed interval and MainPump will turn on 5 minutes later.

To initiate a Feed Cycle select Manual Control:Feed menu item. Also pressing the Down button while the Run Display (see section 'Home Display' on page 15) is active will initiate a Feed Cycle. The display should say Feed and give a countdown of the number of seconds left. When the countdown has terminated the pumps will resume normal operation. The Feed Cycle can be shortened or canceled by pressing the Cancel button (right function) during the countdown.

Externally Switched Events

The AquaController Apex is capable of sensing whether or not an external switch is open or closed and uses that information to operate a control module. The switch inputs are brought into the AquaController Apex by six pins on the I/O connector (See section 'Input/Output Connector' on page 45 for a diagram).

One possible use for the external switch input is to monitor the water level in the sump. When the level is too low, the float switch in the sump is open, and the AquaController Apex is informed that the water level is too low via the external switch inputs. Typically, the make up water in reef tanks contains kalkwasser and the following program example shows how kalkwasser addition could be implemented.

```
Fallback Off
If Switch1 Open Then ON
If Switch1 Closed Then OFF
If pH > 8.30 Then OFF
Min Time 010 Then OFF
```

Notice that kalkwasser is only added to the tank if the pH is below 8.30. See section 'Hysteresis' on page 36 for a

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description of the Min Time program statement. There are 6 digital inputs on the AquaController Apex, so valid Switch keywords are 'Switch1', to 'Switch6'. If the probe expansion box (PX 1000) is used then only inputs 1 and 2 are available on the I/O connector

Alarms

The Apex unit supports multiple different alarm types. Audible, email, and outlet activation alarms are all possible on the Apex system. To signal any audible alarm use either the SndAlm or WmAlm outlet name for the program statements. For an email alarm use the EmailAlm outlet name. If you would like to activate or deactivate an EnergyBar or DirectConnect box outlet to turn on an external audible alarm then use statements similar to those described below.

The following program statement makes OFF the initial state for the alarm outlet. If alarms are used, this statement **must** be present and should be first.

```
Set OFF
```

The following program statements signal an alarm if the temperature is greater than 80.0 °F or less than 75.0 °F:

```
If Temp > 80.0F Then ON
If Temp < 75.0 Then ON
```

The following program statements signal an alarm if the pH is greater than 8.5 or less than 7.9.

```
If pH > 8.50 Then ON
If pH < 7.90 Then ON
```

The following program statements signal an alarm if the ORP is greater than 410mV or less than 300mV.

```
If ORP > 410 Then ON
If ORP < 300 Then ON
```

The following program statements signal an alarm if the power has failed.

```
If Power Apex Off 000 Then ON
```

The number after the Power keyword specifies the number of minutes after power is restored to keep the Power statement true.

Some or all of the above alarm conditions may be programmed into the AquaController Apex. Refer to section Program Outlet on page 28 for the procedure to enter the above program statements into the AquaController Apex's memory.

Hysteresis

The Min Time outlet command allows for outlet channels to stay in a particular state for a minimum length of time. This is useful when a control input (pH, temp, or ORP) may oscillate between two values which in turn causes a pump, light, etc. to turn on and off over a very short period of time. For example suppose the following program is used to control kalkwasser addition to a reef tank:

```
If Switch1 OPEN Then ON
If Switch1 Closed Then OFF
If pH > 8.30 Then OFF
```

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The goal of this program is to dose kalkwasser when the water level in the tank is low, and the pH value is not too high. This program mostly works, except when the tank water level is low, and the pH value oscillates between 8.30 and 8.31. In this case the H2O control module may turn on and off rapidly.

To alleviate this problem a hysteresis command is included in the AquaController Apex language. The 'Min Time' command forces the control module to stay in a certain state for a minimum length of time before being allowed to change. The minimum length of time can be specified for both the ON or OFF state. The following program corrects the potential problem:

```
If Switch1 OPEN Then ON
If Switch1 Closed Then OFF
If pH > 8.30 Then OFF
Min Time 010:15 Then OFF
```

The 'Min Time' statement at the end of the program forces the H2O control module to remain in the off state for a minimum of 10 minutes before being allowed to turn back on. The off state was chosen as the "sticky" state so that H2O pump will not stay in the on state for a minimum of 10 minutes 15 seconds; in some systems this may add too much water to the system. In general it is only necessary to use this command when there is single value of a monitored parameter (pH, ORP, or Temp) which can cause the control module to turn both on and off.

Note: In order for either of the above two programs to operate correctly, the statements must be in the same order as shown above. The AquaController Apex evaluates the program statements from top to bottom, and if the 'If pH > 8.30' was executed first the desired operation would not be achieved.

Defer Command

The Defer outlet command is useful to prevent spurious or momentary glitches in probe/input readings from causing an output to change state. The defer command requires that the internal state of the outlet be in the on/off state for the specified number of minutes/seconds before the outlet state is actually changed. This control statement is useful when a control input (pH, temp, or ORP) may have an inaccurate reading for short period of time and will keep the output from triggering during this event. For example suppose the following is used to signal an audible alarm (programmed on the SndAlm_16 outlet) if the pH is greater than 8.30:

```
Set Off
If pH > 8.30 Then ON
Defer 000:30 Then ON
```

If some external electrical interference causes the pH to have a momentary glitch in its reading then the defer command will filter out this spurious reading. In the above example the pH must be above 8.30 for at least 30 seconds before the outlet (sound alarm) will turn on.

Outlet State Statements

The AquaController Apex adds a new outlet evaluation statement which allows the state of another outlet to activate or deactivate an outlet. The following example illustrates the use of this statement:

Assuming that an outlet name "Light" is programmed as below

```
If Time 08:00 to 20:00 ON
```

A pump outlet can then reference the state of the Light outlet to create a more complex control operation.

```
OSC 010:00/015:00/00:00 Then ON
If Outlet Light = OFF Then OFF
```

These statements cause the pump to oscillate for 10 minutes off and then 15 minutes on and the If Outlet statement causes the pump to be shut off if the light is off.

Variable Speed Ports

NOTE: The Apex Lite base module does not include any built-in variable speed output ports, so the following features are not present in the Lite base module. You can, however, add an AquaSurf to the Lite system and then use it to control variable speed pumps like the Tunze Streams using profiles as described below.

The Apex base module has 4 built-in variable speed output ports which can be used to control many different types of 0-10V compatible devices. Typical uses include dimming T5 ballasts, and varying the speed to Tunze stream pumps. The same programming statements are used to control these ports, however, profiles can be used to take advantage of some of these special features. To make a variable speed pump or dimming capable light use a profile simply substitute the ON or OFF keyword with the profile name in program statement.

Profiles

Profiles are used to specify which mode a variable speed pump should operate in. Profiles allow for the independent specification of the intensity, on and off periods, and synchronization parameter. The Apex base module supports up to 16 different profiles.

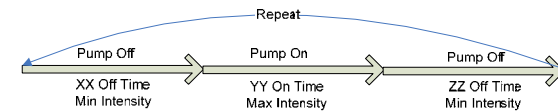
Profiles are setup in the setup->Profile Setup menu. Either the profile type can be modified in the Edit Type menu, or the settings of the profile can be modified in the Edit Settings menu.

If the modify profile type is selected the profile name and profile type can be modified. If the modify profile times is selected the intensity, synchronization, and on/off times of the profile can be adjusted.

Profile Pump Type

This profile is typically used with pumps on the variable speed ports so that resonate type waves may be generated

Where XX is the initial off time, YY is the on time, and ZZ is the second off time. These times can be either specify seconds or tenths of seconds (see the Pump MODE statement for details). The following diagram illustrates, how the osc statement works:



The intensity values are in percent; 000 is off, and 100 is full on. For stream pumps, it is recommended to set the minimum intensity level above 30 percent. Tunze does not recommend using intensity values between 1 and 29%.

There are two modifiers of the profile which can be used to change its behavior.

Synchronize: Synchronize pumps on/off cycle with the previous (lower numbered pump). If synchronization is enabled for the profile, the pump will initially held in the exit off state until the previous pump advances to the initial off state (i.e. both pumps will start in the initial off state at the same time). This mode is particularly useful when trying to generate waves through constructive interference. If synchronization is enabled for pump 2, then it will be synchronized to pump 1. Lower case 's' disables synchronization for the pump, and it starts its initial cycle at an arbitrary time.

Divide times by 10. If enabled the times specified in the profiles on and off times are divided by 10. OSC (time resolution is .1 seconds), and the time values are from 0.0 to 9.9 seconds. When off the time values are in seconds (from 0 to 99 seconds).

Profile Ramp Type

The Ramp profile type allows for a pump or more commonly a light to be gradually ramped up or down in intensity. There are three different fields that may be sent for this profile type.

- Ramp Time: The number of minutes for the ramp up or down of the intensity.
- Start Intensity: The starting intensity in percent. 0% is off, and 100% is full on.
- End Intensity: The ending intensity in percent. 0% is off, and 100% is full on.

Profile Examples

Resonate (Wave) Mode

Since the AquaSurf allows for very precise time of the on off times, it is possible to create large waves in the tank by constructive interference. Following is an example which generates 2+nd waves in a 55 gallon (3 foot) tank with a single 6000 Stream.

Set PF1

In the below table are the on/off times used to generate waves in our test tanks. The values used in your tank may be slightly different but these should be a good starting point.

Tank Width (feet)	Off Time	On Time
3'	0.6 Seconds	0.5 Seconds
4'	0.8 Seconds	0.8 Seconds
6'	1.2 Seconds	1.2 Seconds
8'	1.7 Seconds	1.8 Seconds

Alternate Pumps

If it is desired to have two pumps alternate back and forth with a period of 10 seconds on and then 10 seconds off use:

For Left Pump:

Set PF1

For Right Pump:

Set PF2

PF1	PF2
Sync: Disable Div 10: Disable Min Int: 30 Max Int: 80 Initial Off Time: 10 On Time: 10 Off Time: 00	Sync: Disable Div 10: Disable Min Int: 30 Max Int: 80 Initial Off Time: 0 On Time: 10 Off Time: 10

Growing Surg

If it is desired to have four pumps come on one at a time 5 seconds apart, and remain on so that a growing surge can be created use the following:

For VarSpd1_11 output:

Set PF1

For VarSpd2_12 output:

Set PF2

For VarSpd3_13 output:

Set PF3

For VarSpd4_14 output:

Set PF4

Where the profiles are defined as:

PF1	PF2	PF3	PF4
Sync: Disable Div 10: Disable Min Int: 0 Max Int: 80 Initial Off Time: 5 On Time: 20 Off Time: 00	Sync: Enable Div 10: Disable Min Int: 0 Max Int: 80 Initial Off Time: 10 On Time: 15 Off Time: 00	Sync: Enable Div 10: Disable Min Int: 0 Max Int: 80 Initial Off Time: 15 On Time: 10 Off Time: 00	Sync: Enable Div 10: Disable Min Int: 0 Max Int: 80 Initial Off Time: 20 On Time: 5 Off Time: 00

Advanced Programming

This section explains some of the complicated programming styles which are possible with the AquaController Apex. Most users will not have to worry about these subtleties. If you attempt to program the AquaController

Apex in a non-standard way, experiment with the program on a non-critical sub-system of the tank. A buggy program could be potentially dangerous to your tank's inhabitants.

Statement Evaluation Order

Most programs do not care which way program statements are entered, however there are some cases in which order is important.

1. Program statements are evaluated from the first statement to the last. The last program statement which is true is used to set the state of the outlet. Statements later in the program are higher priority.
2. If the evaluated state is different than the actual timer state then a control command is sent out. The actual outlet state is updated.
3. Steps 1 & 2 are continually executed as fast as possible. Depending on the program complexity the lists are usually evaluated 1 to 2 times/sec.

Language Reference

Statements

Statement	Notes
If Time 0800 to 2000 Then ON	The time statement evaluates to true when the controller time is between start time and end time. In the example start time is 800 am and end time is 800 PM. Times are entered in 24 hour format.
If DoW SMT-TTS Then OFF	The Day statement allows outlets to only be turn on/off on certain days of the week. A capital letter for each day indicates that the statement will be true on that particular day of the week. A dash (-) indicates that the statement will be false on that day of the week. In the statement will be true on every day but Wednesday. On every day but Wednesday the outlet will be shut off.
If Sun 020/-040 Then ON	The 'If Sun' statement allows for lights to follow the seasonal lighting table. The numeric fields are used to adjust the sunrise and sunset times. The first number is the number of minutes to add to the seasonal sunrise time, and the second number is the number of minutes to add to the seasonal sunset time. In this example the light will turn on 20 minutes after sunrise, and off 40 minutes before sunset.
If Moon 000/000 Then ON	The 'If Moon' statement allows for lunar lights to turn on and off in phase with the actual lunar cycle. The numeric fields are used to adjust the moonrise and moonset times. The first number is the number of minutes to add to the moonrise time, and the second number is the number of minutes to add to the moonset time.

OSC 01000/01500/0000 Then ON	The oscillate statement is used to program periodic on/off cycles and is typically used for wavemaker functionality. The first numeric field is the initial off time, the second field is the on time, and the third field is the second off time. The three separate numeric fields allows multiple outlets to be configured so that they remain in phase with one another if so desired. All number fields are in minutes/seconds.
If pH > 8.20 Then OFF	The 'If pH' statement allows for an outlet to be turned on/off in response to the pH reading. In this example the outlet will be turned off if the pH is greater than 8.20. To specify a second pH probe on the Apex base unit use pH12. To specify a probe expansion pH probe use pH1A1, pH1A2, pH1B1, etc where the letter following specifies the expansion module, and the number is either first or second pH probe.
If ORP < 300 Then OFF	The 'If ORP' statement allows for an outlet to be turned on/off in response to the ORP reading. In this example the outlet will be turned off if the ORP is less than 300. To specify a probe expansion ORP probe use ORPA, ORPB, ORPC, etc where the letter following specifies the expansion module.
If Temp > 78.0 Then OFF	The 'If Temp' statement allows for an outlet to be turned on/off in response to the temperature reading. In this example the outlet will be turned off if the temperature is greater than 300. To specify a probe expansion temperature probe use TEMP A, TEMPB, TEMPC, etc where the letter following specifies the expansion module.
If Temp > RT+1.0 Then OFF	The 'If Temp' statement with the RT+ option allows for an outlet to be turned on/off based upon the seasonal temperature table. In this example the outlet will be turned off if the temperature reading is greater than the seasonal value plus 1.0 degree. To specify a probe expansion temperature probe use TEMPA, TEMPB, TEMPC, etc where the letter following specifies the expansion module.
If Switch1 OPEN Then OFF	The 'If Switch' statement allows for an outlet to be turned on/off in response to one of the 6 digital inputs on the Apex base module, or the inputs of a probe module. In this example the outlet is turned off if switch 1 is open. To specify a input on a probe expansion module use SWITCHA1 to SWITCHA6 for expansion module A, SWITCHB1 to SWITCHB6 for expansion module B, etc.
If Power Apex Off 010 Then ON If Power EB8_3 On 005 Then OFF	The 'If Power' statement allows for outlets to be turned on/off in response to whether or not power is present to the Apex base unit or any of the EnergyBars. In the first example if power to the Apex base module is off, and for 10 minutes after power is restored the outlet will be turned on. In the second example if power to the EnergyBar with module address 3 is on and for 5 minutes after power is failed the outlet has turned off.

If Outlet Light = OFF Then OFF	The 'If Outlet' statement allows for the state of an outlet or a virtual outlet to turn on or another outlet. This is a very powerful statement which can be used to create complex logic by combining the state from other outlets or virtual outlets. In the example if the outlet named Light is in the off state, then this outlet is also turned off.
Min Time 03:00 Then OFF Min Time 00:15 Then ON	The 'Min Time' statement allows for an outlet to stay in a particular on or off statement for a minimum amount of time. The number parameter specifies the number of minutes and seconds to keep the outlet in the specified state before it can be changed to the opposite state. Both a Min Time ... Then ON, and Min Time ... Then OFF can be specified for each outlet. In the first example, the outlet will be kept in the off state for at least 30 minutes before it is allowed to turn back on. In the second example the outlet will be in the on state for at least 2 minutes 15 seconds before it can turn off.
Defer 00:35 Then OFF	The Defer statement requires that the internal state of the outlet be in the on or off state for the specified number of minutes/seconds before the outlet state is actually changed. In the example the internal state of the outlet must be in the off state for 3 minutes 45 seconds before the outlet is actually turned off.
Fallback OFF	The Fallback statement specifies a fail safe state for the outlet in the event of a communication failure between the Apex base module and the EnergyBar.

6. Other Connectors

Input/Output Connector

The input output connector allows the AquaController Apex to be directly receive additional digital input or to control devices via a direct connection.

The 6 digital inputs are TTL compatible with internal pull up resistor inside the AquaController Apex. The input voltage must be limited to be between 0 and 5V. Voltages outside this range may result in permanent damage to the AquaController Apex. No external voltage should be applied to these inputs.

Input Connector Pinout

Following is the pinout of the input port (Minidin 8). This diagram assumes that you are looking at the connector on the AquaController Apex.

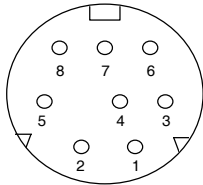


Figure 12: Input/Output Port Connector

Pin Number	Description
1	Input #1
2	Input #2
3	Input #3
4	Input #4
5	Input #5
6	Input #6
7	Reserved
8	Ground

Figure 13: Input/Output Port Signal Description

Any dry contact switch can be connected to any of the AquaController's digital inputs. No external voltage source is required. One wire from the mechanical switch should connect to the ground pin (pin 8), and the other wire from the switch should connect to one of the six digital inputs (pin 1-6).

The easiest way to connect 3rd party equipment to Apex digital inputs is with the IO breakout box. The breakout box has quick connection terminals and connecting wires to it only requires opening/closing of the connector with fingers. No soldering or tools are required.

NOTE: If a PX 1000 is used with the Apex system (probe expansion enabled in the setup->probe exp menu), then inputs 3, 4, 5, and 6 are not available.

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Appendix A: Trouble Shooting

For the latest trouble shooting information, see the support section of www.neptunsys.com. Also support is always available by sending an email to support@neptunsys.com or you can contact Neptune Systems at 408-578-3022 during business hours (9:00 – 5:00 PST M-F).

Appendix B: Telnet Commands

The telnet interface allows for the user to access the controller data through a text based user interface.

Telnet Commands

The following commands are available from the Ethernet telnet interface. They are all single letter commands which are executed by typing the letter followed by a carriage return.

- l The list command will display all the defined outlet names and program statements. This command is useful in debugging the program used by the AquaController Apex.
- c The current status command will display the current conditions in the aquarium. It will also list the state of all the control modules.
- d The data log command will print to the telnet port the latest data logs in the Apex flash memory.
- on XXX This command puts device XXX in manual mode and turns it on. XXX is the outlet name. Example: on LT1
- off XXX This command puts device XXX in manual mode and turns it off. XXX is the outlet name. Example: off LT1
- auto XXX This command puts device XXX into automatic module. XXX is the outlet name. Example: auto LT1

Appendix C: Sample Programs

The following default program is programmed into the non-volatile memory of the AquaController Apex. The program has the capability to control 2 pumps, 2 lights, the pH level, the ORP level, and the temperature. The current program and settings can be erased and the following default program loaded at anytime by selecting 'Init Memory' from the 'Setup' menu.

Default Outlet Configuration

When an EnergyBar is added to the system it is automatically detected, and configured to the default configuration shown below. Also if a Direct Connect 8 is manually added to the system it will have this same default configuration. See Add Module on Page 17 for details on how to manually add modules to the system.

Default Program

The following program is the default program in the AquaController Apex's non-volatile memory.

Light 1

Fallback Off

Set Off

If Time 08:00 to 20:00 Then ON

Light 2

Fallback Off

Set Off

If Time 08:30 to 19:30 Then ON

Pump 1

Fallback On

OSC 000:00/005:00/005:00 Then ON

If FeedA 000 Then OFF

Pump 2

Fallback On

OSC 005:00/005:00/000:00 Then ON

If FeedA 000 Then OFF

Heater

Fallback Off

If Temp < 77.0 Then ON

If Temp > 78.0 Then OFF

Chiller

Fallback Off

If Temp > 79.0 Then ON

If Temp < 78.0 Then OFF

CO2

Fallback Off

If pH > 8.00 Then ON

If pH < 7.90 Then OFF
Ozone

Fallback Off

If ORP > 375 Then ON

If ORP < 360 Then OFF

Neptune Systems Limited Warranty

Neptune Systems warrants this product (excluding probes) to be free from defects in material and workmanship for a period of 1 year from the date of purchase. Probes carry a 90-day warranty. If repair or adjustment is necessary and has not been the result of abuse, misuse, or accidental damage, within the 1 year period, please return the product with proof of purchase, and correction of the defect will be made without charge. Opening any Neptune Systems product voids the warranty.

For your protection, items being returned must be carefully packed to prevent damage in shipment and insured against possible damage or loss. Neptune Systems will not be responsible for damage resulting from careless or insufficient packaging. Before returning please obtain a return authorization (RMA) number from Neptune Systems at (408) 578-3022. Returned merchandise will not be accepted without a RMA number.

Except for the warranty set forth above, Neptune Systems is not responsible for any damages including, but not limited to, consequential damage occurring out of or in connection with the delivery, use or performance of Neptune Systems' products. Buyer's remedies for breach of warranty shall be limited to repair, or replacement and full or partial adjustment to purchase price.

Information in this manual is subject to change without notice. Please see www.neptunessys.com for the latest product information and product updates.
