AquaController II Owner's Manual

Version 1.60

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AquaController II Owner's Manual V1.60
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Chapter 1

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 II to perform any task.

Feature List

The following features are fully supported in the AquaController II base unit.

?? Lighting Control
?? Wave Maker
?? Simulated Moon Cycle
?? Seasonal Lighting Variation
?? Seasonal Temperature Variation
?? 1 External Switch Input
?? Temperature Monitor and Control
?? pH Monitor and Control
?? ORP Monitor and Control
?? Flash Memory for Easy Firmware Upgrades
?? Data Logging
?? RS232 Computer Interface

?? Direct Connection to External Modem
?? Local and Remote Alarms
?? Simple Yet Sophisticated Programming Language
?? Built in Self Test

Chapter 2

2. Getting Started

Base Unit Installation

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

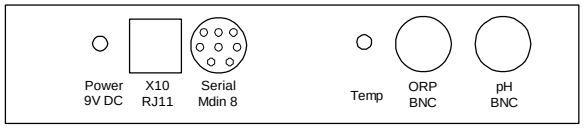

Figure 1: AquaController II Connectors

The AquaController II should be installed in a dry environment that has little chance of getting wet. The AquaController II is a sensitive piece of electronic equipment and is not waterproof. Ideally, it should be located several feet from the aquarium. Velcro strips with adhesive backing can be used to install the controller in its permanent location. Velcro strips work well because the unit can be easily removed from its mounting point to replace the 9V battery.

To prevent the loss of data logging and clock information, it is highly recommended that a new 9V battery is installed. In the event of a power outage the battery will maintain the internal state of the unit and allow for the resumption of control of the aquarium as soon as power returns. A high quality alkaline battery will keep the internal processor operational for approximately 4 hours when an AC power failure occurs. When the battery is low and should be replaced a 'battery low' display will flash on the AquaController II's Display. It should be noted that no state changes will occur in the external control modules during a power outage. After

power is returned, all controlled devices will be in the correct state within the Repeat Interval. The default interval is 5 minutes. See section 'Repeat Interval' on page 32 for more details on modifying the Repeat Interval.

The 9V-DC power adapter should be plugged into a 120V wall socket and the plug on the end of the cable should be connected to the power connector on the AquaController II. Refer to the above figure for the location of the connector.

Powerheads and pumps switching on and off generate power spikes that can damage electronic equipment. The AquaController II has protection circuitry in the base unit; however, it is recommended as an added safety precaution to plug the controller in a 'clean' AC socket. Power strips with transient suppression circuitry can be used to make a 'clean' socket and to prevent power surges from damaging the AquaController II. Coil up all power cords to reduce the amount of radiated electrical noise.

Control Interface Installation

Simply plug the control interface into the wall outlet located close to the AquaController II and aquarium. It may be necessary to use one or more power strips if multiple devices are to be controlled. Plug one end of the cable with the RJ11 connectors (phone cable) into the Control Interface and the other end into the AquaController II.

Serial Port Installation

Macintosh Installation

To connect the AquaController II to a Macintosh computer simply use an Apple NULL modem (printer) cable. The cable necessary is exactly the same as is used to connect two Apple Macintosh's together over an AppleTalk network. Simply place one of the mini-DIN 8 connectors into the AquaController II serial port (see figure 1) and the other end into the modem or printer port of the Macintosh.

Any of the many serial port communications programs for the Macintosh can be used. Kermit is one such public domain program. The communications program on the Macintosh must be configured to run at 9600 baud, 8 bits/char, no parity, 1 stop bit and no flow control. Also make sure that the correct serial port (printer or modem) on the Macintosh

is selected.

To test the port type several carriage returns and an AquaController> prompt should be returned. At this point data can be downloaded from the AquaController II to the host Macintosh. Please refer to section Serial Port Commands' on page 52 for a detailed description of the serial port commands.

PC Compatible Installation

To connect the AquaController II to an IBM/PC compatible computer use our serial cable (P/N SERPC). To install simply place the mini-DIN 8 connector into the AquaController II serial port (see figure 1) and the DB25 connector into the PC's serial port. For PCs with DB9 connector a DB25 to DB9 converter is required in addition to the serial cable.

Any of the many serial port communications programs for the PC can be used. The terminal emulator in Windows (Hyperterminal) or a public domain program such as Kermit will both work. The communications program on the PC must be configured to run at 9600 baud, 8 bits/char, no parity, 1 stop bit and no flow control. Also make sure that the correct serial port is selected (COM1 or COM2).

To test the port type several carriage returns and an AquaController> prompt should be returned. At this point data can be downloaded from the AquaController II to the host PC. Please refer to section Serial Port Commands' on page 52 for a detailed description of the serial port commands.

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Chapter 3

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. When the cursor reaches the bottom entry and the down button is pressed again, the menu items scroll as expected. Similarly, if the cursor is at the top and the up button is pressed, the menu items scroll. 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.

The menu choices are in a circularly linked list, so repeated presses of the Up (or Down) button will cycle through all the choices. Common to all menus is the Exit entry. When Exit is selected, 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 II, all three 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.

For quick reference the following table lists all of the menus and commands available to the AquaController II. On the left side of the table are the root menu entries. Entries in the 2nd through 4th columns are sub-menus of the column to the left of it.

Root Level	2nd Level	3rd Level	4th Level
Run			
Control & Status	Feed		
	Manual Cntl		
	Power Fail Log	Power Log	
		Reset Power Log	
		Exit	
	Display Lock		
	Exit		
Data Log	Print Data Log		
	Display Log (T, pH, ORP)		
	Display Log (Oxy, Cond)		
	Reset Data Log		
	Log Interval		
	Exit		
Setup	Timer Setup	Timer Names	Modify Name
			Add Name
			Delete Name
			Exit
		Timer Program	Modify State
			Add State
			Delete State
			Exit
		Repeat Interval	
		Feed Interval	
		Exit	
	Clock Setup	Tank Time Set	
		Clock Time Set	
		Type: Adv/Normal	
		Leap Second	
		Exit	
	pH Setup	pH Calibration	
		pH: On/Off	
		pH Temp Comp:	
		Exit	
	Temp Setup	Temp Calibration	
		Temp: On/Off	
		Temp Celsius	
		Temp Fahrenheit	
		Exit	
	ORP Setup	ORP Calibrate	
		ORP: On/Off	
		ORP pH Comp:	
		Exit	

Root Level	2nd Level	3rd Level	4th Level
	Login Setup	Login: On/Off	
		Login Name	
		Login Password	
	Pager Setup	Pager: On/Off	
		Pager Number	
		Dial Delay	
		Repage Delay	
		Alarm Name:	
	Serial Setup	Type: RS232/RS485	
		Exit	
	Init Memory		
	Exit		

Run Display

The Run Display indicates the date, system time, temperature (temp), pH, and ORP. During most of the AquaController II operation this will be the active display. If no input occurs (button selection) the LCD screen will automatically return to this display. It can be selected by pressing the Select (left) button when the arrow cursor is pointing at RUN.

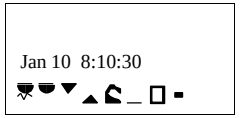

Figure 2: Clock Display

In Figure 2 Normal Clocking is enabled and the first line displays the date (month day) followed by the tank time (hour:minute:second). The clock Time can also displayed by setting Advanced Clocking to ON (see section "Enabling/Disabling Advanced Clocking" on page 19).

The second line indicates the current status of the control modules; the first character represents the status of the first timer name, the second character represents the status of the second timer name and so on. If the character displayed is either an "M" or "m" then that timer is in manual mode (operation). The "M" indicates that the controlled device is operating and the "m" indicates the device is idle. Manual Mode Operation is described in section "Control and Status" on page 16

The other special characters displayed on this line indicate that the timer is in Automatic mode, and the controlled device(s) are either "on" or "off".

The character that is displayed for a particular timer is programmed in the 'Setup:Timer Setup:Timer Names' sub-menu. The following table shows the special characters (the first column represents on and the second off):

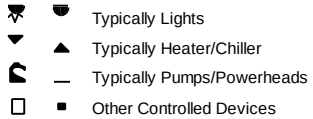

Figure 3: Run Display Special Characters

In the figure below the monitored probes are displayed. with temperature (°F or °C), pH, and ORP (millivolts) enabled. The **UP** button is used to toggle between the Clock Display and the Monitored Probes display.

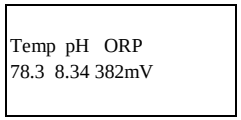

Figure 4: Monitored Probes Display

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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 Select button can be used to end the Feed Cycle early. See section "Feed Cycle" on page 16 for more details.

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

Control and Status

The control and status menu option allows the user to take any timer out of the automatic mode of operation and force it to either an "on" or "off" state as well as viewing other operational 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 Control and Status menu. When this mode is entered, the Feed Cycle controlled modules 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 Select button. See section "Feed Cycle Timer Events" on page 44 for instructions on how to program a timer to use a Feed Cycle and section "Feed Interval" on page 33 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 Run Display command. When the Run Display is active (see section "Run Display" on page 15), the Down button can be used to initiate a Feed Cycle.

Manual Control

The manual timer menu allows you to place a control module out of Automatic Mode and turn it continuously "on" or continuously "off". The following procedure is used to modify the on, off or automatic status of a timer:

1. Go to the Control & Status:Manual Control menu.
2. Use the Up and Down buttons to locate the desired timer. When the cursor points to the desired timer press the Select button.
3. The underline cursor should now be under the ON, OFF, or AUTO status of the timer. Use the Up and Down buttons to scroll to the desired state. Press the Select button to complete the operation.

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".

Data Logging

Data logging is a powerful feature that 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 AquaController IIs internal memory can hold up to 744 data logs. This size log buffer is enough to hold hourly data logs for four weeks. When the data log exceeds 744 entries, the oldest log entry is replaced by the newest log entry.

Print Data Log

The Print Data Log menu dumps the entire data log to the serial port. It may take several seconds to dump the Data Log to the serial port, so be patient. This operation cannot be interrupted. A terminal program on a PC can capture the dumped data, and allows you to store it to disk. The data can then be input into a spreadsheet, or similar program to generate graphs or find trends. Refer to section "Serial Port Installation" on page 10 for instructions on how to attach the serial port to a computer. The 'd' command input from the serial port performs the same function.

Display Data Log

The Display Data Log menu allows you to scroll through the contents of the data log on the LCD screen. The first line displays the Month/Day Hour:Minute of the datalog entry and the second line displays the Temperature, pH, and ORP.

The initial display shows the earliest data entry and the Down button scrolls to a later data entry. The Up button scrolls the display to an earlier data entry. To exit the Display Data Log menu press the Select button.

Reset Data Log

The Reset Data Log menu option clears the log memory in the AquaController II. NOTE: The data log is also cleared if the tank time is changed or the log interval is modified. The 'r' reset command from the

serial port performs the same function.

Log Interval

The Log Interval menu allows you to set how often the AquaController II logs a pH, ORP, or temperature measurement to the data log. To modify the interval select Log Interval and use the Up and Down buttons to advance to the desired setting. When the correct interval is displayed press the Select button. Sixty minutes is the default setting for log interval. NOTE: The data log is also cleared if the tank time is changed or the log interval is modified.

Setup

Timer Setup

The timer setup and programming instructions are described in chapter 5 on page 31

Clock Setup

Setting the Tank Time or Clock Time.

The AquaController II has the capability to maintain two separate times on two separate clocks. The tank clock keeps track of the time in the tank and is the clock used by the timer program to turn off or on the desired modules. The time clock is only included as a convenience to the user. It can be set to display the actual time in case it is different than the time used to control and monitor the tank. Following the directions listed below can set either clock:

1. Go to the Setup:Clock Setup:
2. Select either Set Tank Time or Set Clock 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.

Enabling/Disabling Advanced Clocking

Since some of the lighting control statements (SUN and MOON) occur at fixed times, you may want to have the Tank Time and Clock Time set to different times; Advanced clocking allows for this possibility. The Advanced Clocking feature enables both the Tank Time and the Clock

Time to be visible in the Run Display simultaneously. If Advanced Clocking is disabled only the tank time is displayed in the Run Display. The Tank Clock is always used in the timer program evaluation regardless of the setting of Advanced Clocking. To enable or display Advanced Clocking do the following:

1. Go to the Setup:Clock Setup:
2. Use the Up and Down buttons to move the cursor to either Adv Clocking. When the cursor is positioned by the correct action press the Select button; the clock mode will toggle.
3. To exit the clock setup menu, use the Up and Down buttons to scroll through the options to the 'Exit' entry. Press the Select button to exit the clock setup menu.

Leap Seconds

The Leap Seconds allows the user to fine tune the accuracy of the clocks used in the AquaController II. The number programmed into the AquaController II 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 II 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 the correct value is displayed press the Select button.

Temperature Setup

Temperature setup and probe installation are described in section 'Temperature Probe Installation' on page 25 and 'Temperature Calibration' on page 27.

pH Setup

pH setup and probe installation are described in section 'pH Probe Installation' on page 25 and 'pH Calibration' on page 27.

ORP Setup

ORP setup and probe installation are described in section 'ORP Probe Installation' on page 26 and 'ORP Calibration' on page 28.

Login Setup

This ROM version supports a modem so that a telephone connection is possible without having a PC at the remote AquaController II site. For this feature to work the AquaController II needs to be connected to the modem with the modem serial cable. Our technical support department supports only modems sold by Neptune Systems. Other Hayes command set modem may work with the AquaController II, however, we make no guarantees.

The following configuration must be set correctly for Login to function. The login setup menu is found in Setup->Login Setup.

Login: On or Off
This menu turns login on or off. If **On** password login is enabled. Login should be enabled only if the AquaController II is connected directly to a modem, otherwise it should be left off.

Login Name
This menu allows for the setting of login name. The up and down keys scroll through the letters of the alphabet and the select key moves to the next letter. The space character is used to signal the end of the login name if less than 8 characters are entered. This field is limited to 8 characters.

Login Password
This menu allows for the setting of login password. The up and down keys scroll through the letters of the alphabet and the select key moves to the next letter. The space character is used to signal the end of the login name if less than 8 characters are entered. This field is limited to 8 characters.

Pager Setup

The following configuration must be set correctly for Alarm paging to function. The pager setup menu is found in Setup->Pager Setup.

Pager Enable
This menu turns paging on or off. If On paging is enabled.

Pager Number
This field is self-explanatory; this number is called if an alarm condition is on. The space character is used to signal the end of the pager number if less than 16 numbers/characters are entered. Some special characters other than numbers may be entered into the phone number. The following table lists and describes these characters:

Character	Meaning
W	Wait unit dial tone before dialing
,	Pause 2 seconds
*	Send the '*' tone
#	Send the '#' tone
+	

Alarm Name
This field is used by the AquaController II to determine which timer name to monitor for an alarm condition. The default name is ALM. Repeatedly pressing the select button scrolls through all the available timer names.

NOTE: The timer name does not necessarily have to control a physical alarm module

Dial Delay
This field determines how long to delay after the pager number is dialed to enter the AquaController II serial number, temperature, pH, and ORP data. Most paging services work with a 5 second delay.

Re-page Delay
This field determines how long the AquaController II will wait before repaging. The default is 60 minutes.

Pager Test
This entry will send a test page that contains the current AquaController II conditions.

Init Memory

Executing the command will initialize the AquaController II's memory with the default program and calibration constants. A listing of the default program can be found in Appendix B.

Self Test

The Self Test feature of the AquaController II 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 II firmware as well as the controller's serial number.

The 'Aqua Serial' tab on the Communications Settings window allows for the configuration of the serial interface between each AquaController II and the PC.

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Chapter

4

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 II to the aquarium or the sump. It should be installed in a vertical position where there is adequate water flow.

The AquaController II must be informed that a temperature probe has been installed. This is accomplished by following this procedure:

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

To remove Temperature from the AquaController II display follow the above procedure and instead select Temp Off in step 2.

pH Probe Installation

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 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. The pH probe should be placed at least 6 inches away from the ORP probe to prevent interference.

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

The AquaController II 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 II display follow the above procedure and instead select pH Off in step 2.

ORP Probe Installation

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. The ORP probe should be placed at least 6 inches away from the pH probe to prevent interference.

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

The AquaController II 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 II display follow the above procedure and instead select ORP Off in step 2.

Probe Calibration

Calibration of the AquaController II 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 II. 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 is 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 II 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 II 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 II's pH circuitry. A two-point calibration scheme is used to obtain 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 Setup:pH 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 lowest valued calibration solution 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

It is not necessary to calibrate the ORP probe of the AquaController II. 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.

2. Select Setup:ORP Setup:ORP Calibrate from the AquaController II'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.

Chapter

5

5. Programming the AquaController II

The AquaController II 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 are entered through the three button user interface of the base controller unit and follow the same user interface as the menu navigation commands. The Up and Down buttons navigate through the various options of the fields. The Select button advances to the next field or completes the command entry.

The program and configuration information input are stored in the AquaController II's non-volatile memory. Power failures do not affect the contents of this memory even if the 9V backup battery is not installed.

The default program installed in the AquaController II is listed in Appendix A. Most users will only have to make minor modifications to this program to control and monitor their aquatic system.

Programming Basics

Timer Names

The first step in setting up the AquaController II for any type of control is deciding which communication channel is to be used for a controlled device. It does not matter which channel is used, only that it is unique for each device in the household. For example, one control module is to be used to control the heater in the aquarium. The description name HET^ is chosen for the timer name, and it is assigned the communication ID of A1. Make sure that the control modules communications ID matches the ID that is associated with the Timer Name.

To program the AquaController II with this communication ID and Timer Name, the following procedure is used:

1. Go to the Setup:Timer Setup:Timer Names menu.
2. Select Add Name from the menu.
3. Input a 4 character descriptive name for this timer channel (HET^ in the above example). Use the Up and Down buttons to scroll through the alphabet and the Select button to advance to the next character. The fourth character entered is special in that it is displayed on the Run screen to indicate that status of the controlled device.
4. Input the communications ID letter and number next. These letters and numbers should match channel IDs set on the control module earlier.

Timer Program

The AquaController II uses a simple programming language to control the external modules. The program statements are input through the three button interface. The procedure below illustrates how to input a typical program statement:

1. Go to the Setup:Timer Setup:Timer Program menu.
2. Select 'Add State' from the menu.
3. Use the Up and Down buttons to locate the desired token (word). When it is displayed use the Select button to advance to the next input field.
4. Continue to input the control statements until finished by jumping back to step 2. If a mistake is made entering a statement, the Modify State command from the Setup:Timer Setup:Timer Program can be used to correct it.

Repeat Interval

The Repeat Interval defines how often the AquaController II

retransmits commands to the remote control 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. The following procedure is used if you chose to modify this parameter:

1. Go to the Setup:Timer Setup:Repeat Interval menu.
2. Use the Up/Down buttons to enter the desired Repeat Interval (minutes). When finished push the Select button.

Feed Interval

The Feed Interval menu allows you to change the length of time for a Feed Cycle. The procedure for modifying it is described below:

1. Go to the Setup:Timer Setup:Feed Interval menu.
2. Use the Up/Down buttons to enter the desired feed interval (minutes). When finished push the Select button.

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 II 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 II is capable of controlling a heater, a chiller, or both.

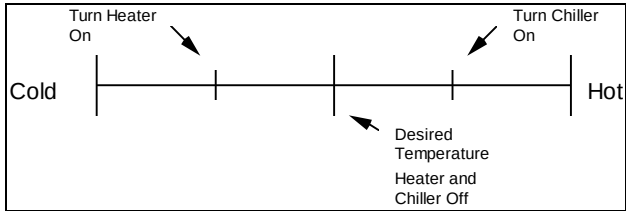

Figure 5: Temperature Scale

The above figure illustrates the mechanism that 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 assuming that the heater timer name is 'HET^':

```
If Temp < 76.7
    Then HET^ ON

If Temp > 77.0
    Then HET^ OFF
```

For the chiller control described above the following code produces the desired result assuming that the chiller timer name is 'COL^':

```
If Temp > 77.3
    Then COL^ ON

If Temp < 77.0
    Then COL^ 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 II.

NOTE: The default factory setting comes with the HET^ and COL^ timer names already installed to ease the initial setup. Choose the 'Modify Name' command from the Setup:Timer Setup:Timer Name menu to modify the names and channel IDs. Also the 'Delete Name' can be used to remove unwanted names.

NOTE: The default factory setting comes with generic heater and chiller programs already installed to ease the initial setup. Choose the 'Modify State' command from the Setup:Timer Setup:Timer Program menu to modify the temperatures. Also the 'Delete State' can be used to remove unwanted statements.

Seasonal Temperature Variation

One of the AquaController II'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:

```
If Temp < RT+-0.4
    Then HET^ ON

If Temp > RT+0.0
    Then HET^ OFF
```

The above statements turn the heater (HET) 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:

```
If Temp > RT+0.4
    Then COL^ ON

If Temp < RT+0.0
    Then COL^ 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).

pH Controller Setup

pH is perhaps one of the most critical parameters to maintaining successful aquariums. Many reef aquariums that 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 II, since it continuously monitors the pH and can enable / disable CO2 injection at the appropriate times.

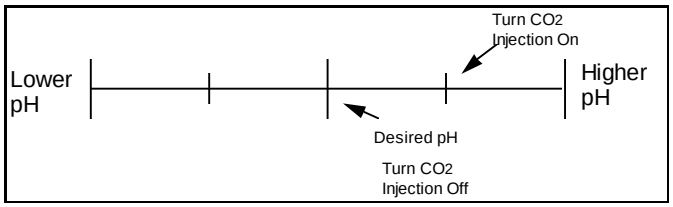

Figure 6: pH Scale

The above figure illustrates the mechanism that 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 timer name is 'CO2$':

```
If pH > 8.40
      Then CO2$ ON

If pH < 8.35
      Then CO2$ OFF
```

NOTE: The default factory setting comes with the CO2$ timer name already installed to ease the initial setup. Choose the Modify Name command from the Setup:Timer Setup:Timer Name menu to modify the name and channel IDs. Also the Delete Name can be used to remove unwanted names.

NOTE: The default factory setting comes with a generic pH control program already installed to ease the initial setup. Choose the Modify State command from the Setup:Timer Setup:Timer Program menu to modify the pH set points. Also the Delete State can be used to remove

unwanted statements.

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 that 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. The AquaController II can do this task easily since it continuously monitors the ORP and can enable and disable ozone injection at the appropriate times.

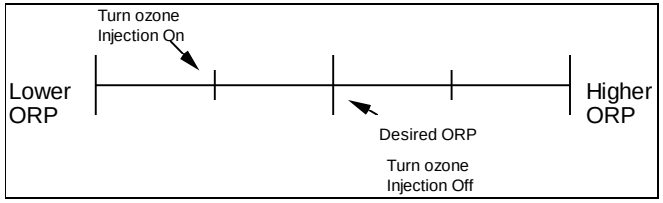

Figure 7: ORP Scale

The above figure illustrates the mechanism that 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 timer name is 'OZN$':

```
IF ORP < 365
```

Then OZN$ ON

If ORP > 375
Then OZN$ OFF

NOTE: The default factory setting comes with the ozone timer name already installed to ease the initial setup. Choose the Modify Name command from the Setup:Timer Setup:Timer Name menu to modify the name and channel IDs. Also the Delete Name can be used to remove unwanted names.

NOTE: The default factory setting comes with a generic ORP control program already installed to ease the initial setup. Choose the Modify State command from the Setup:Timer Setup:Timer Program menu to modify the ORP set points. Also the Delete State can be used to remove unwanted statements.

Timed Events Setup

The AquaController II can control such devices as lights, pumps, power-heads, and chemical dosing. The AquaController II 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 II are compared with the Tank Time clock not the Normal Time 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 timer names are LT1* and LT2*. NOTE: The AquaController II time display is in 24 hour military format.

IF Time > 08:29

Then LT1* ON

If Time > 21:29
Then LT1* OFF

IF Time > 09:29
Then LT2* ON

If Time > 20:29
Then LT2* OFF

NOTE: The default factory setting comes with the LT1* and LT2* timer names already installed to ease the initial setup. Choose the Modify Name command from the Setup:Timer Setup:Timer Name menu to modify the names and channel IDs. Also the Delete Name can be used to remove unwanted names.

NOTE: The default factory setting comes with generic lighting programs already installed to ease the initial setup. Choose the Modify State command from the Setup:Timer Setup:Timer Program menu to modify the enabled and disabled times. Also the Delete State can be used to remove unwanted statements.

Timed Pumps

The AquaController II 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 that are alternately turned on and off.

The following AquaController II code will produce this effect:

If Time > 00:00
Then PM1% OFF

IF Time > 06:00
Then PM1% ON

If Time > 12:00
Then PM1% OFF

IF Time > 18:00
Then PM1% ON

If Time > 00:00
Then PM2% ON

IF Time > 06:00
Then PM2% OFF

If Time > 12:00
Then PM2% ON

IF Time > 18:00
Then PM2% OFF

This program assumes that pump 1 (PM1%) and pump 2 (PM2%) are located on opposite ends of the aquarium. Refer to section Programming Basics' on page 31 for instructions on how to program the timer names and this code into the AquaController II.

Repetitive and Random Events

Suppose that it is desired to have a power-head oscillate on for 20 minutes and off for 10 minutes, and another power-head in the system should be randomly turned on for 1 to 10 minutes and off for 1 to 15 minutes.

The following AquaController II code will produce this effect:

OSC 20/10 ON/OFF
Then PM1% ON

RND 10/15 ON/OFF
Then PM2% ON

The abbreviations OSC and RND stand for oscillate and random respectively. The code assumes that power-head 1's timer name is PM1% and power-head 2's timer name is PM2%. Refer to section Programming Basics' on page 31 for instructions on how to program the timer names and this code into the AquaController II.

The wave maker capability of the AquaController II 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.

OSC 20/20 ON/OFF
Then PM1% ON

OSC 20/20 ON/OFF
Then PM2% OFF

The only tricky part about the above code is that the ON or OFF value following the timer name (PM1% or PM2%) determines what the initial condition of the pumps will be at power on. In the above example PM1% will be on and PM2% will be off when the controller is first powered on.

Seasonal Lighting Variation

One of the AquaController IIs 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:

```
If Sun 000/000
    Then LT1* ON

If Sun 060/-045
    Then LT2* ON
```

The first statement turns on the first light (LT1) at sunrise of the particular day and off at sunset. The second program statement turns on the second light (LT2) 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 IIs 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 II'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. During a new moon the moonrise is in the morning and the moonset is in the evening. During a full moon the moonrise time is in the evening and the moonset time is in the morning. So it is possible for the moonlight 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 MON* ON
```

Refer to section "Programming Basics" on page 31 for instructions on how to program the timer names and this code into the AquaController II.

The first statement turns on the first light (MON) at the moonrise of the particular day and off at the moonset. The control module used to control the light source for the Moon cycle must be a **lamp module** so that the light intensity can be varied. NOTE: Only use an incandescent light bulb for the moonlight, not a fluorescent bulb.

Feed Cycle Timer Events

The AquaController II is capable of shutting off certain devices for a period of time and then resuming normal operation. This behavior is desirable for the main pumps and powerheads 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.

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

```
If Time > 00:00
    Then PM1% ON

OSC 20/10 ON/OFF
    Then PM2% ON

If Feed cycle
    Then PM1% OFF

If Feed cycle
    Then PM2% OFF
```

Refer to section "Programming Basics" on page 31 for instructions on how to program the timer names and this code into the AquaController II.

Programming the length of the Feed Cycle time interval is described in section "Feed Interval" on page 33.

To initiate a Feed Cycle select Manual Control:Feed menu item. Also pressing the Down button while the Run Display (see section "Run 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 Select button during the countdown.

Externally Switched Events

The AquaController II 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 II by two pins on the serial connector (See section "Serial Connector Pinout" on page 51 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 II 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.

```
If Switch OPEN
   Then H2O ON

If Switch Closed
   Then H2O OFF

If pH > 8.30
   Then H2O OFF

Max Change 010 M
```



```
Then H2O OFF
```

Notice that kalkwasser is only added to the tank if the pH is below 8.30. See section "Hysteresis" on page 47 for a description of the Max Change program statement.

Alarms

The AquaController II is capable of signaling out of range conditions in the Aquarium. By using an Alarm Module (CM506) and the appropriate program setup in the AquaController II, an audible tone can be signaled when the monitored conditions exceed a setpoint. The program statements below describe how to setup the AquaController II for out of range conditions on pH, ORP, and temperature.

First, add a timer name. Refer to section "Timer Names" on page 31 for a detailed description on the procedure to perform this task. For the example following the timer name is assumed to be ALM^ on channel A09. In addition to making the alarm modules address match the address programmed into the AquaController II, the switches on the Alarm module should be set to "Sounder Only" and "Continuous".

The following program statement makes OFF the default state for the ALM control module. If alarms are used, this statement **must** be present.

```
If Time > 01:00
   Then ALM^ OFF
```

The following program statements signal an alarm if the temperature is greater than 80.0 ?F or less than 75.0 ?F. The alarm timer name is assumed to be ALM^:

```
If Temp > 80.0F
   Then ALM^ ON

If Temp < 75.0
      Then ALM^ ON
```

The following program statements signal an alarm if the pH is greater

than 8.5 or less than 7.9. The alarm timer name is assumed to be ALM^:

```
If pH > 8.50
   Then ALM^ ON

If pH < 7.90
   Then ALM^ ON
```

The following program statements signal an alarm if the ORP is greater than 410mV or less than 300mV. The alarm timer name is assumed to be ALM^:

```
If ORP > 410
   Then ALM^ ON

If ORP < 300
   Then ALM^ ON
```

The following program statements signal an alarm if the power has failed or the battery is too low. The alarm timer name is assumed to be ALM^:

```
If Power Fail
   Then ALM^ ON

If Battery Low
   Then ALM^ ON
```

Some or all of the above alarm conditions may be programmed into the AquaController II. Refer to section Timer Program on page 32 for the procedure to enter the above program statements into the AquaController II's memory.

Hysteresis

The MAX Change timer command allows for timer 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 Switch OPEN
   Then H2O ON

If Switch Closed
   Then H2O OFF

If pH > 8.30
   Then H2O OFF
```

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 II language. The 'MAX change' 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 either the ON or OFF state but not both. The following program corrects the potential problem:

```
If Switch OPEN
   Then H2O ON

If Switch Closed
   Then H2O OFF

If pH > 8.30
      Then H2O OFF

Max Change 010 M
      Then H2O OFF
```

The 'Max Change' 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; 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, Temp) that 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 II 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.

Advanced Programming

This section explains some of the complicated programming styles that are possible with the AquaController II. Most users will not have to worry about these subtleties. If you attempt to program the AquaController II 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. The program statements are executed in the ordered listed by entering the serial port command 'l'. The one exception to this rule is program statements that start with 'If Time'. The 'If Time' statements are executed first regardless of where they are located in the program code. This requirement is necessary due to the circular nature of 'Time' type statements (i.e. the cycle repeats day after day). The execution order can also be displayed on the LCD screen by selecting Modify State in Setup:Timer Setup:Timer Program:Timer and scrolling from first statement to the last by pressing the Down button.

Chapter

6

6. Serial Port Interface

Refer to the installation chapter to setup the serial port connection between the AquaController II and the computer. If it is installed correctly an 'AquaController>' prompt should be displayed after every carriage return.

Serial Connector Pinout

Following is the pinout of the serial port. This diagram assumes that you are looking at the connector on the AquaController II.

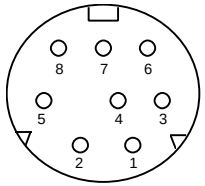

Figure 10: Serial Port Connector

Pin Number	Description
1	External Switch Output
2	External Switch Input
3	Serial Transmit Data
4	Ground
5	Serial Receive Data
6	Ground
7	Reserved
8	Ground

Figure 11: Serial Port Signal Description

Serial Port Commands

The following commands are available from the serial port. They are executed by typing the command followed by a carriage return (<Enter>).

l — The list command will display all the defined timer names and program statements. This command is useful in debugging the program used by the AquaController II.

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 serial port all the data logged by the AquaController II.

r — The reset datalog will initialize the data log memory and set the number of log entries to zero.

on XXX — This command puts device XXX in manual mode and turns it on. XXX is the timer name. Example: on LT1

off XXX — This command puts device XXX in manual mode and turns it off. XXX is the timer name. Example: off LT1

auto XXX — This command puts device XXX into automatic module. XXX is the timer name. Example: auto LT1

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Appendix A - Trouble Shooting

Problem	Possible Cause	Possible Solution
No Display.	The base unit has no power.	Make sure the AC adapter is installed in the base unit and the wall socket correctly.
	The base unit control program is hung.	Remove the battery and AC power from the AquaController II for 10 seconds. Reapply power and the AquaController II will reset.
Incorrect pH or ORP readings.	The probes are not correctly calibrated.	Calibrate the particular probe.
	The probes are old or defective.	Replace the probe.
	There is s ground loop created by a tank grounding probe and the serial port.	Remove the ground probe or the serial port connection. The ground isolated serial connector sold by Neptune Systems can be used with a normal serial cable to break ground loops..
No control modules operating.	The control interface module is not connected to the base unit.	Attach the interface module to the base unit.
Some control modules do not operate in both manual and auto mode.	The control module and timer name addresses are not the same.	Make the both addresses the same. See section **Timer Names** ’on page 31.
A control module does not operate in auto mode.	The timer module is in manual mode as indicated by an m or M in the run screen.	Put the timer in automatic mode. See section **Manual Control** ’on page 17.
	The control program is incorrect.	Examine the timer control statements for correctness.
Compact florescent lights turn on when it is suppose to be off. Every other controlled device works correctly.	The standard control modules have a feature called local control, which causes the control module to turn on if the input impedance changes.	1. Plug an additional load into the control module controlling the lights. 2. Or disable local control in the control module. Contact technical support for details.

Appendix B - Sample Programs

The following default program is programmed into the non-volatile memory of the AquaController II. 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 Timer Names

The notes following the semicolon are comments and not part of the program.

```
LT1-A01          ; Light 1 on Channel A01.
LT2-A02          ; Light 2 on Channel A02.
PM1-A03          ; Pump 1 on Channel A03.
PM2-A04          ; Pump 2 on Channel A04.
HET-A05          ; Heater on Channel A05.
COL-A06          ; Chiller on Channel A06.
OZN-A07          ; Ozone on Channel A07.
CO2-A08          ; CO2 on Channel A08.
ALM-A09          ; Alarm module on Channel A09
```

Default Program

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

```
If Time > 08:30 Then LT1 ON
If Time > 21:30 Then LT1 OFF
If Time > 09:30 Then LT2 ON
If Time > 20:30 Then LT2 OFF
If Temp > 77.0 Then COL ON
If Temp < 76.5 Then COL OFF
If Temp < 76.0 Then HET ON
```



```
If Temp > 76.5 Then HET OFF
OSC 010/010 ON/OFF Then PM1 ON
OSC 010/010 ON/OFF Then PM2 OFF
If Feed cycle Then PM1 OFF
If Feed cycle Then PM2 OFF
If ORP  < 365 Then OZN ON
If ORP  > 385 Then OZN OFF
If pH   > 8.45 Then CO2 ON
If pH   < 8.35 Then CO2 OFF
If Time > 00:00 Then ALM OFF
If pH   > 8.50 Then ALM ON
If pH   < 8.00 Then ALM ON
If ORP  > 450 Then ALM ON
If ORP  < 300 Then ALM ON
If Temp < 75.0 Then ALM ON
If Temp > 78.0 Then ALM ON
```

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 the AquaController II base unit voids this 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.