Aquatic Habitats

C351

Control and Monitoring System

AquaticHabitats™

2395 Apopka Boulevard
Apopka, Florida 32703 USA
Telephone 407/886-3939
Fax 407/886-6787
Email aes@aquaticeco.com
Website www.aquaticeco.com

I. THEORY OF OPERATION

A. Water Quality Monitoring

The C351 Control and Monitoring System (hereafter referred to as the controller) will have the ability to monitor 6 predetermined water quality parameters using various sensors and probes. The water quality parameters will consist of:

1. Temperature (°C)
2. pH
3. Conductivity (µS)
4. Dissolved Oxygen or Total Dissolved Gas (%)
5. Flow (GPM)
6. Tank Level (in) or Float Switches

All water quality parameters will have **alarm points** which will be input by the user. If the current value read by a probe is greater than or equal to the high alarm point or less than or equal to the low alarm point for the probe's parameter for an uninterrupted period of 60 seconds, an alarm will be generated.

Certain water quality parameters will have **cutoff points** which will be input by the user. If the current value read by a probe is greater than or equal to the high cutoff point or less than or equal to the low cutoff point for the probe's parameter for an uninterrupted period of 5 seconds, a cutoff alarm will be generated and all output devices powered by the controller will be turned off.

B. Output Device Control

The controller will provide power to 7 predetermined output devices. These devices will consist of:

1. Water Pump
2. Air Pump
3. Ultra-Violet Sterilizer
4. Heater or Chiller
5. Water Exchange Solenoid
6. pH Dosing Pump
7. Conductivity Dosing Pump

2395 Apopka Boulevard
Apopka, Florida 32703 USA
Telephone 407/886-3939
Fax 407/886-6787
Email aes@aquaticeco.com
Website www.aquaticeco.com

A device will be permitted to run when all the following conditions are met:

- The device is in HAND or AUTO mode
- The RUN button is active
- There are no active or pending cutoff alarms
- User programmable conditions are met in AUTO mode

C. Data Logging and Trending

The controller will log sensor data on the time interval set by the user. The logging interval may range from 1second to 60 minutes. The controller will store 1000 data logs before overwriting old data. The logs can be stored on a remote PC as a .csv or excel file before overwriting occurs.

The controller will plot a point of the current value, alarm points and cutoff points for each water quality parameter on a 1 minute interval, alarm points and cutoff points for each water quality parameter. These trends can be viewed from the controller display and show 2 hours of data. The controller also keeps 2 hours of history samples that can be reviewed.

D. Networking and Communication

The controller may be connected to a LAN or other network with access to the Internet. This enables the controller to utilize alarm emailing, data logging and remote access capabilities. All network functionality is dependent upon administrative rules and security settings of the network. The customer will need to consult with their Information Systems group to properly configure the network settings.

The controller will also contain a normally closed dry contact output which may be connected to an auto dialer system. The auto dialer will call out whenever a power failure occurs or a cutoff alarm is received.

AquaticHabitats™
2395 Apopka Boulevard
Apopka, Florida 32703 USA
Telephone 407/886-3939
Fax 407/886-6787
Email aes@aquaticeco.com
Website www.aquaticeco.com

II.   I/O CONFIGURATION

A. Digital In (24V)

- Low Float Switch (I3)
- High Float Switch (I4)

B. Digital Out (120V)

- Water Pump (O0)
- Air Pump (constant 120V power)
- Ultra-Violet Sterilizer (O1)
- Heater/Chiller (O2)
- Water Exchange (O3)
- pH Dosing Pump (O4)
- Auto Dialer Relay (O5)
- Conductivity Dosing Pump (O6)

C. Analog In (4-20mA)

- Dissolved Oxygen or Total Dissolved Gas (AN0)
- pH (AN1)
- Conductivity (AN2)
- Temperature (AN3)
- Flow (AN4)
- Tank Level (AN5)

2395 Apopka Boulevard
Apopka, Florida 32703 USA
Telephone 407/886-3939
Fax 407/886-6787
Email aes@aquaticeco.com
Website www.aquaticeco.com

III. HARDWARE CONFIGURATION

A. System Configuration

Controller designed to be factory installed and wired. HMI Display, PLC, and all terminations are included in control panel. All power and signal connections are quick disconnecting for easy replacement. Controller is designed, manufactured, and certified in accordance with UL 508A Standards.

B. HMI Display

3.5" 256-color TFT touchscreen display is integrated with PLC module. Display shows current status of system as well as option menus for adjusting set point values. The touchscreen is factory calibrated for ensured accuracy and may be adjusted at any time from the Calibration Screen. The Calibration Screen may be accessed by pressing and holding an empty portion of the screen for several seconds.

C. PLC

The Unitronics V350-35-TR6 PLC is factory programmed to monitor and control specific I/O points. All cables must be wired and connected correctly for PLC logic to function as desired. Wires and connections should only be changed by or under the supervision of a trained professional.

D. Communication

The V100-17-ET2 Ethernet port can be used to connect the controller to a network such as a LAN or the Internet. The controller may be accessed via Remote Operator software from any PC running Windows. The controller's communication settings must be configured by the customer. Ability to communicate over certain networks is subject to all security measures and protocols put in place by the network administrator.

AquaticHabitats™

2395 Apopka Boulevard
Apopka, Florida 32703 USA
Telephone 407/886-3939
Fax 407/886-6787
Email aes@aquaticeco.com
Website www.aquaticeco.com

IV. PROGRAM OPERATION

A. *Status Display*

The Status Display is the first display shown when the controller is initially powered on. This display shows all information monitored and controlled by the controller.
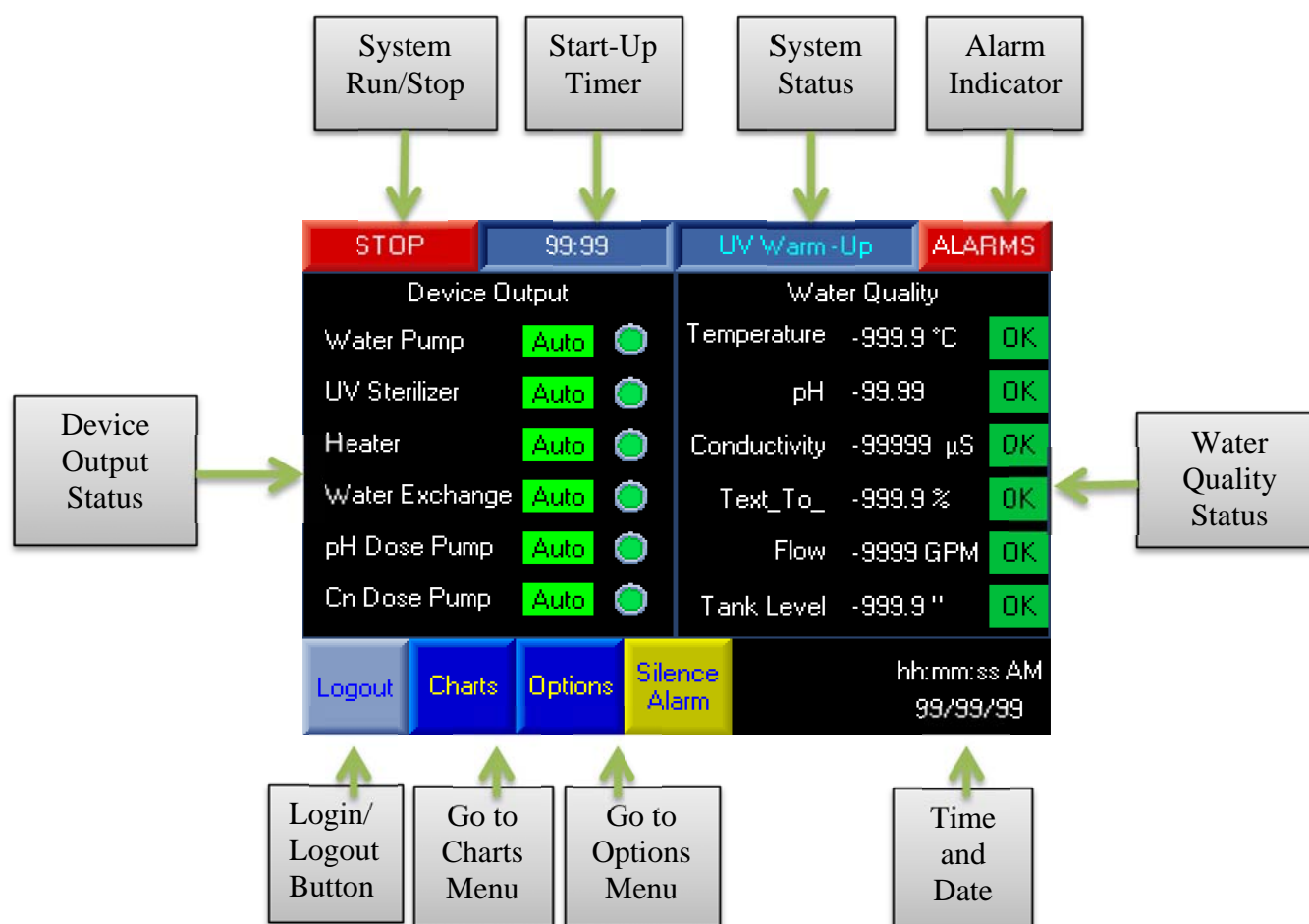
System Run/Stop: Initiates start-up and stops system operation
Start-Up Timer: Shows time remaining in the Start-Up processes
System Status: Shows the current controller operating status or process
Alarm Indicator: Appears when an alarm is pending for acknowledgment
Device Output Status: Shows the operating mode and state of each device
Water Quality Status: Shows the current value and status of each parameter

B. Starting and Stopping the System

The controller can be started and stopped from the status display using the System Run/Stop button located in the top, left corner. To put the system in running mode, press the **RUN** button. The controller will only allow you to start the system if **OK to Restart** appears in the System Status box.

If the System Status box reads **System Cutoff** the user must either address an active cutoff parameter or acknowledge a pending cutoff alarm.

To check whether an alarm is active and/or pending, press the **ALARMS** button in the top, right corner or the F1 soft key.

To put the system in stop mode, press the **STOP** button. This will shut down all devices and stop the system from monitoring all alarms.

C. Start-Up Sequence

The controller will go through a start-up sequence each time the **RUN** button is pressed. There are 3 phases to the start-up sequence:

1. **UV Warm-Up:** Allows time for the UV to reach full power before water circulation begins
2. **Dosing Hold:** Allows time for water to circulate through the system for accurate sensor measurements before dosing may occur
3. **Alarm Hold:** Allows time before system begins monitoring alarms to ensure that the system is fully stabilized.

The time remaining in each phase of the Start-Up Sequence can be monitored in the Start-Up Timer box to the left of the System Status box. The length of each phase can be set in the "Advanced Settings" options menu.

AquaticHabitats™

2395 Apopka Boulevard
Apopka, Florida 32703 USA
Telephone 407/886-3939
Fax 407/886-6787
Email aes@aquaticeco.com
Website www.aquaticeco.com

D. Device Control

The current operating mode and state of each device can be seen in the Device Output Status portion of the screen. There are 3 device modes and 2 device states:

- **Device Modes**

  Hand Device will remain on as long as the system is in RUN mode

  Off Device will remain off at all times

  Auto Device will turn on and off based on programmed parameters

- **Device Status**

  Indicates that the device is running

  Indicates that the device is stopped

The mode of a device may be changed in the "Output Settings" Menu.

E. Water Quality

The current value and status of each water quality parameter can be seen in the Water Quality Status portion of the screen. A current value and status will only appear for a parameter if the sensor is connected. There are 5 water quality statuses:

OK Parameter current value is within specified limits

L Parameter current value is lower than low alarm set point

H Parameter current value is higher than high alarm set point

LC Parameter current value is lower than low cutoff set point

HC Parameter current value is higher than high cutoff set point

To return a parameter to the OK status, the current value must be brought back within specified limits and the alarm must be acknowledged in the Alarms Menu.

F. Alarms Menu

When an alarm occurs, the instance of the alarm is recorded and can be seen from the Alarms Menu by pressing the **ALARMS** button in the top, right corner or the F1 soft key. There are 3 screens in the Alarms Menu:

- **Groups with Pending Alarms:** Shows all groups with active or pending alarms

- **Alarms in Group:** Shows alarms within a specific group

- **Alarm Details:** Shows information for a specific alarm

Use the button to navigate forward through the menus and **ESC** to go back to the previous menu.

To acknowledge a pending alarm, enter the Alarm Details menu for the specific alarm and press the **Ack** button. Acknowledging an alarm will stop the controller from attempting to send out email and phone notifications. The alarm can be acknowledged even if it is still active. A cutoff alarm must be both acknowledged and not active for the system to allow a restart.

G. Charts Menu

Trends for each water quality parameter may be viewed by pressing the

Charts button in the bottom, left corner of the Status Display. The Charts Menu lists each of the 6 water quality parameters monitored. Press the blue parameter button to view the chart for that parameter.

Each chart displays the current value trend, alarm limits and cutoff limits for a parameter. Press the alarm name along the right side of the display to toggle between showing and hiding a particular trend.

AquaticHabitats™

2395 Apopka Boulevard
Apopka, Florida 32703 USA
Telephone 407/886-3939
Fax 407/886-6787
Email aes@aquaticeco.com
Website www.aquaticeco.com

Press the minimum and maximum points on the Y-axis to change the scale of the graph.

Press the [M] button to pause the graph and cycle through previous data.

Press the [G] button to toggle between showing and hiding gridlines.

H. Options Menu

a. Password Protection

Press the [Login] button to login to the controller. Before the controller will allow access, the 4-digit password must be entered. Press the blue button under "Enter Password" to bring up the number pad. Press the enter button to submit the password. The default password for the controller is 1234. You must be logged in to start the system. You do not need to be logged in to stop the system. The controller will automatically log out after 20 minutes of inactivity.

b. Output Settings

The Output Settings menu allows the user to change the operating mode of each device. Press the mode button to the right of the device name to toggle between Hand, Off and Auto modes.

To accept changes made to the device mode, press the [SAVE] button in the bottom, right corner.

c. System Settings

i. Water Ex Settings

The Water Ex Settings menu allows the user to configure the parameters for automatic water exchange. There are 4 values that are needed:

1. Capacity: Volume of system in liters

2. Water Ex %: Percentage of capacity discharged
3. Water Ex Flow: Flow speed past water ex solenoid
4. Water Ex Interval: Length of a water ex cycle

The controller uses these 4 values to determine how long the water exchange valve must be open during each interval to discharge the percentage specified.
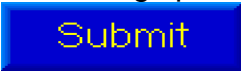
ii. **Advanced Settings**

The Advanced Settings menu allows the user to set timer durations and screen brightness.

- **Screen Saver:** length of time before display is dimmed
- **UV Warm-Up:** Allows time for the UV to reach full power before water circulation begins
- **Dosing Hold:** Allows time for water to circulate through the system for accurate sensor measurements before dosing may occur
- **Alarm Hold:** Allows time before system begins monitoring alarms to ensure that the system is fully stabilized
- **Logging Interval:** Length of time between data samples

iii. **Password Settings**

The Password Settings menu allows the user to change the password for accessing the Options Menu and starting the system. To change the password:

1. Press the blue box under "Enter Password" and enter the current password
2. Press the blue box under "Enter New Password" and enter a 4-digit password
3. Press the blue box under "Re-enter New Password" and enter the same 4-digit password from the previous step
4. Press the **Submit** button

iv. **Maintenances**

The Maintenances menu shows total run time and usage for devices and filtration. There are 2 menus:

1. **Equipment Usage**: Shows run time of devices and dosing pump cycles
2. **Filtration Usage**: Shows time since last filter inspections

To reset a usage timer or counter back to 0, press the **Reset** button.

d. Communication Settings

i. Network Settings

The Network Settings menu allows the user to configure the controller to access a network such as a LAN or the Internet. This allows the options of remote access and email notifications. The following information must be entered:

- **PLC Name:** Unique name for the controller used for remotely accessing the system.
- **IP Address:** Unique static IP address for the controller that is a part of the network being connected to.
- **Subnet Mask:** indicates which portion of the address identifies the network and which portion of the address identifies the node.
- **Default GW:** The IP address assigned to the gateway device is generally the last available address.
- **Local Port:** Port number used to communicate via remote access program, typically 20256.
- **HTTP Port:** Port number used to communicate with controller web server.

Whenever a change is made on the Network Settings menu, the controller must be power cycled before the changes will take place. This can be done be unplugging the controller from the wall or cycling the on/off switch on the front of the I/O Box.

ii. Email Settings

The Email Settings menu allows the user to set up the controller for email notifications in the event of an alarm. The following information must be entered:

AquaticHabitats™
2395 Apopka Boulevard
Apopka, Florida 32703 USA
Telephone 407/886-3939
Fax 407/886-6787
Email aes@aquaticeco.com
Website www.aquaticeco.com

- **Recipients:** Press the **Enter Recipients** button to view the Recipients list. You must enter a valid email address for all 5 recipients.
- **Remote Mail Server:** IP Address of the outgoing mail server used for sending email.
- **Sender Email:** Email address that is associated with the outgoing mail server being used.
- **User Name:** For authenticated servers that require a user name.
- **Password:** For authenticated servers that require a password.
- **Outgoing Mail Port:** Port used for sending outgoing messages. Typically 25.
- **Test Email:** Press to send a test email and verify email settings.
- **Email Reminder:** Sets the amount of time an alarm can go without being acknowledged before a follow up email is sent.

e. Water Quality Settings

The Water Quality Settings menu contains the setup menus for each sensor monitored by the controller. The menus have many similar attributes as well as unique traits specific to certain parameters. All menus contain Low and High alarm set points:

These alarm set points are used to notify personnel by audible alarm and email only and do not control the operation of any devices.

AquaticHabitats™
2395 Apopka Boulevard
Apopka, Florida 32703 USA
Telephone 407/886-3939
Fax 407/886-6787
Email aes@aquaticeco.com
Website www.aquaticeco.com

Some parameters contain Low and/or High cutoff points:

| High Cutoff | -999.9 °C |
| Low Cutoff | -999.9 °C |

These cutoff points are used for shutting down the system to prevent circulation of water that is unsafe for tank inhabitants. The controller will notify personnel by audible alarm, email and phone. The parameter which cut off the system must be rectified and the system must be manually restarted from the controller.

Some parameters contain dosing cycle timers for controlling dose and dwell times:

Time ON
99999 sec
Time OFF
99999 sec

These timers help prevent overshooting set points and allow time for the sensors to accurately access the water quality before dosing continues. By entering a value of 0 for Time OFF the system will dose continuously until the set point value is reached.

i. **Temperature Settings**

The temperature sensor can control either a heater or a chiller based on the toggle button in the bottom, middle of the screen. The heater or chiller will operate under the following conditions when in Auto Mode:

When in Heater mode, the controller will allow the current water temperature to drop down to the Hysteresis point before powering the heater. The heater will be turned on for the Time ON period specified and off for the Time OFF period until the current temperature is greater than or equal to the set point temperature.

When in Chiller mode, the controller will allow the current water temperature to rise up to the Hysteresis point before powering the chiller. The chiller will be turned on for the Time ON period specified and off for the Time OFF period until the current temperature is less than or equal to the set point temperature.

ii. **pH Settings**

The pH sensor controls the pH dosing pump. The pH dosing pump will operate under the following conditions when in Auto Mode:

The controller will allow the current pH level to drop 1/10th of a point below the set point value before turning on the pH dosing pump. The pH dosing pump will be turned on for the Time ON period specified and off for the Time OFF period until the current pH is greater than or equal to the set point pH.

iii. **Conductivity Settings**

The conductivity sensor controls the conductivity dosing pump. The conductivity dosing pump will operate under the following conditions when in Auto Mode:

The controller will allow the current conductivity level to drop 30µS below the set point value before turning on the conductivity dosing pump. The conductivity dosing pump will be turned on for the Time ON period specified and off for the Time OFF period until the current conductivity is greater than or equal to the set point conductivity.

iv. **Total Dissolved Gas – Dissolved Oxygen Settings**

The controller will monitor total dissolved gas (TDG) or dissolved oxygen (DO) based on the sensor that is connected to the controller. Both sensors monitor % saturation of gas in water.

v. **Flow Settings**

The flow sensor must be mounted on top of a horizontal pipe to read accurately. Flow is monitored to help identify when a line has become clogged and to verify correct flow rate through the system.

vi. **Level Settings**

The level sensor monitors water level in the main sump. Once a low water level cutoff occurs, the water level must be increased to the "OK to Restart" level before the alarm will go inactive.

AquaticHabitats™

2395 Apopka Boulevard
Apopka, Florida 32703 USA
Telephone 407/886-3939
Fax 407/886-6787
Email aes@aquaticeco.com
Website www.aquaticeco.com