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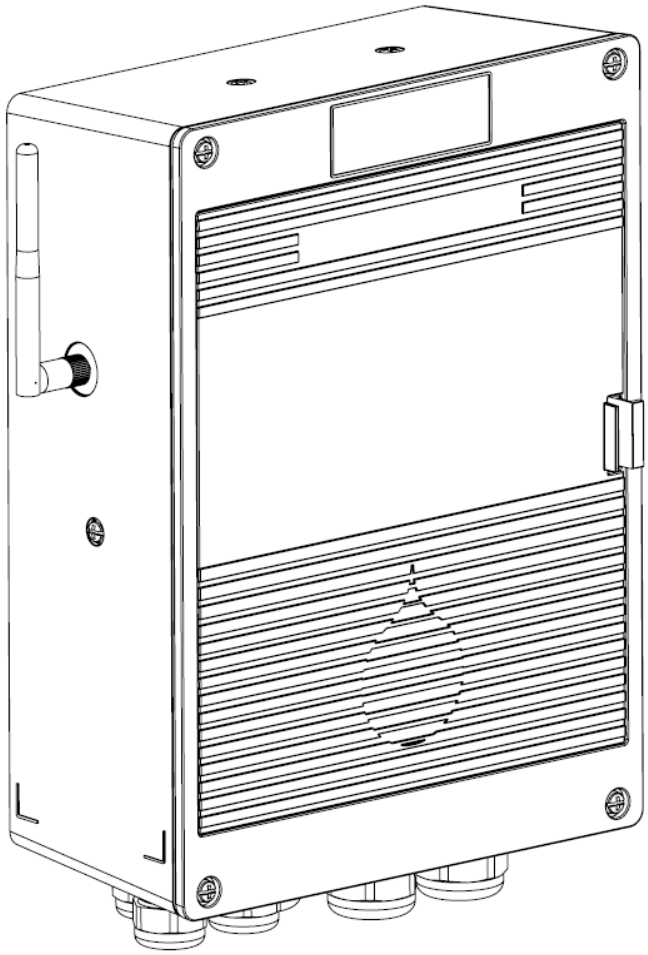

LIQUITRON™

LMI Connect
smart monitoring service

Series 7000 Multi-Dimensional Controller

Installation & Operation Manual

Manual No.: 56424
Revision : 01
Rev. Date: 11/2018

LMI®

an Accudyne Industries brand

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1.0 Precautions

The following precautions should be taken when working with LMI® Liquitron™ Controllers. Please read this section carefully prior to installation.

Electrical Connections

WARNING: To reduce the risk of electrical shock, the controller must be plugged into a properly grounded grounding-type receptacle with ratings conforming to the data on the product label. The controller must be connected to a good ground. *DO NOT USE ADAPTERS!* All wiring must conform to local electrical codes. If the supply cord is damaged, it must be replaced by the manufacturer, stocking distributor, or authorized repair center in order to avoid a hazard.

Ground Fault Circuit Interrupter

WARNING: To reduce the risk of electric shock, install only on a circuit protected by a Ground Fault Circuit Interrupter (GFCI).

Disconnect Power to Service

WARNING: Disconnect power prior to removing the black lid to access the wiring terminals.

Sensor Calibration

Always calibrate sensors to ensure accurate readings.

Cable Glands

Always use the smallest possible hole to route cable through the gland. Ensure gland is fully tightened to prevent water ingression.

2.0 Introduction

The LIQUITRON™ 7000 Series Controller is designed for use in a variety of water treatment applications requiring precise control of total dissolved solids and chemical feed. Among its many uses, the 7000 Series Controller will control conductivity and chemical feed in cooling towers, boilers, waste water, and other closed loop systems.

The 7000 Series Controller simplifies installation and setup using a large, color touchscreen and intuitive initial setup wizard.

The 7000 Series Controller will control four (4) pumps: Biocide 1, Biocide 2, Inhibitor, Acid, Base, Oxidizer, or Reducer. Two (2) of these pumps can be proportionally controlled with pulse outputs. It also controls an external alarm relay and a solenoid or motorized ball valve for blowdown. It monitors four (4) low tank sensors, two (2) flow meters, one (1) flow switch, and three (3) probes: Conductivity, pH, and ORP. There are two (2) 4-20mA outputs for data logging.

2.1 Specifications

Table 1: General Specifications

Enclosure Ingress protection	IP55 / NEMA 3R
Voltage / Frequency	115/230 VAC, 50/60 Hz
Max. Current / Wattage	4 A
Operation environment	Indoor / Outdoor
Operating ambient temperature	-10°C to +50°C (14F to 122F)
Storage temperature	-40°C to +70°C (-40F to 160F)
Standard Probes and Manifold Process Fluid Temperature	0°C to +80°C (32F to 176F)
Boiler Probes and Manifold Process Fluid Temperature	0°C to +204°C (32F to 400F)
Standard Probes and Manifold Process Fluid Pressure	100 PSI (6.9 Bar)
Boiler Probes and Manifold Process Fluid Pressure	250 PSI (17.3 Bar)
Operating humidity range:	0-95% RH (Non-condensing)
Operating Altitude	<2,000 meters
Display	UV Resistant 7” Capacitive Touchscreen with 800 x 480 resolution
Dimensions	8.8” x 11.8” x 4.2” (224mm x 300mm x 105mm)

Table 2: Inputs

Type	Quantity	Specification
Conductivity	1	Cell Constant: 1.0 or 1.5 Range: 0 – 20,000 µS or 0 – 12,820 ppm Resolution: 10 uS
Temperature	1	10 KOhm Thermistor Range: 0 – 100 Degrees C Resolution: 1 Degree C
pH	1	Range: 0 – 14 pH Resolution: 0.01 pH
ORP	1	Range: -2,000 mV - +2,000 mV Resolution: 1 mV
Flow Switch Input	1	Optically isolated providing 24 V power with a nominal 4 mA when closed Dry Contact Reed or Transistor See **Figure 19**
56568 Flow Switch	1	SIKA VK320M0P1CPP3K with 3/4" Tee Increasing Minimum Flow: 2.2 GPM Decreasing Minimum Flow: 2.0 GPM Maximum Flow Rate: 25 GPM
Low Tank	4	Optically isolated providing 24 V power with a nominal 4 mA when closed Dry Contact Reed or Transistor See **Figure 19**
Flow Meter	2	Optically isolated providing 24 V power with a nominal 4 mA when closed Dry Contact Reed or Transistor 24 V Power for Hall Effect Sensor (max 100 mA) Max Rate: 500 Hz Pulse Width: Configurable 1-99 msec

Table 3: Outputs

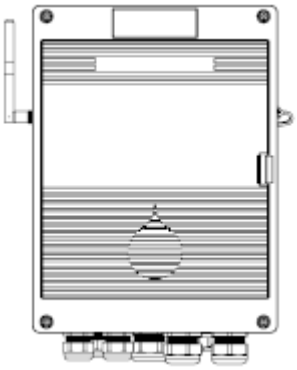
Type	Quantity	Specification
SPST Powered Mechanical Relay	5	Normally Open Relay for powering 4 pumps and 1 external alarm (4A max combined on all relays) Switching Line Voltage
SPDT Powered Mechanical Relay	1	Normally Open and Closed Relay for powering solenoid or motorized ball valve (4A max combined on all relays) Switching Line Voltage
4-20mA Analog Output	2	Drive Voltage: 18-26 V Max Resistance: 600 Ohm Configurable to repeat any probe measurement to chart recorder, PLC, etc.
24V DC Power	2	24V power supply for sensors or flow meters Max Current: 100 mA combined
Digital Pulse Output	2	24V digital pulse Max Rate: 10 Hz

USB 2.0	1	Mass Storage for logs, profiles, and software upgrades Power: 500mA
Embedded Cellular Modem	1	Verizon or AT&T/T-Mobile LTE

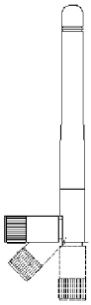
(1) NOTE: All powered relays fused together with 6.3A Slow Blow Fuse.

2.2 Unpacking Check List

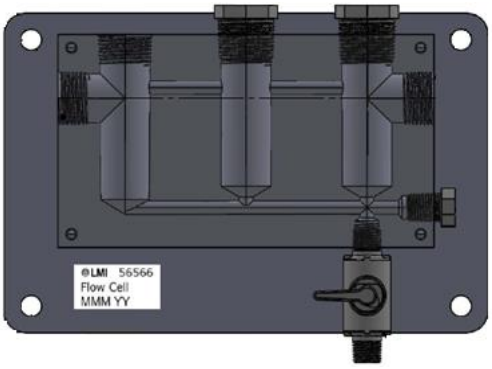
Your carton contains many or all the following items. Please notify the carrier immediately if there are any signs of damage to the parts.



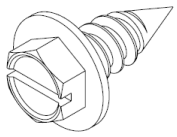
DM7000 Series Controller



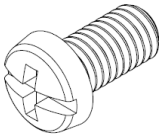
Antenna 56437



Flow Cell 56566 (Optional)



Wall Mounting Screws (4)



Bracket Locking Screws (4)

Conductivity with Temperature Probe 56567 (Optional)

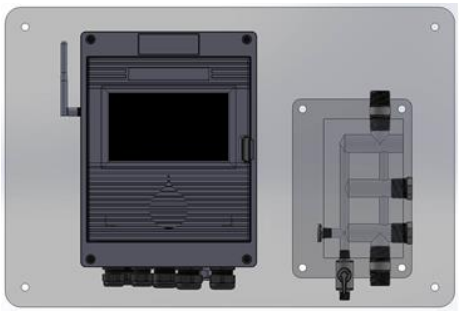
pH Probe 56569 (Optional)

ORP Probe 56570 (Optional)

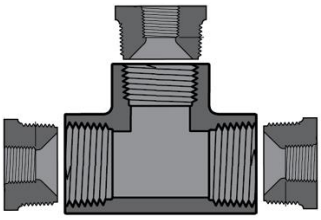
pH/ORP Cable 56572 (Optional)

Temperature Probe 56573 (Optional)

Flow Switch Assembly with one 3/4” NPT Adapter 56568 (Optional)



Mounting Panel (Optional)



Individual Probe Tee. 1" NPT w/ 3 3/4" Reducers 56954 (Optional)

3.0 Installation

3.1 Location and Installation

Locate the controller in an area convenient to create a process fluid bypass loop and provide an electrical supply. When mounting probes inline, ensure the flow cell is always full. Tap off the discharge side of the recirculation pump to provide at least 2.2 gallons per minute of flow.

Air bubbles or drop in water level in flow cell may reduce the useful life of the probes.

The controller should be mounted with the display at eye level with enough clearance to open the lid and access the terminal blocks. It should not be operated in ambient temperatures above 122°F (50°C).

Probes should be placed as close to the controller as possible. The included 20-foot cables for pH and ORP cannot be extended without the use of preamplifiers. The battery powered Sensorex PHAMP-1 may be used with an LMI 56955 BNC-BNC 20-foot extender cable.

If possible, mount the controller on an exterior wall for improved cellular reception for LMI Connect. For best coverage, mount the controller near a corner in the building.

3.2 Controller Mounting

1. Determine the desired position of the controller on the wall. Refer to **Figure 1** for controller dimensions.

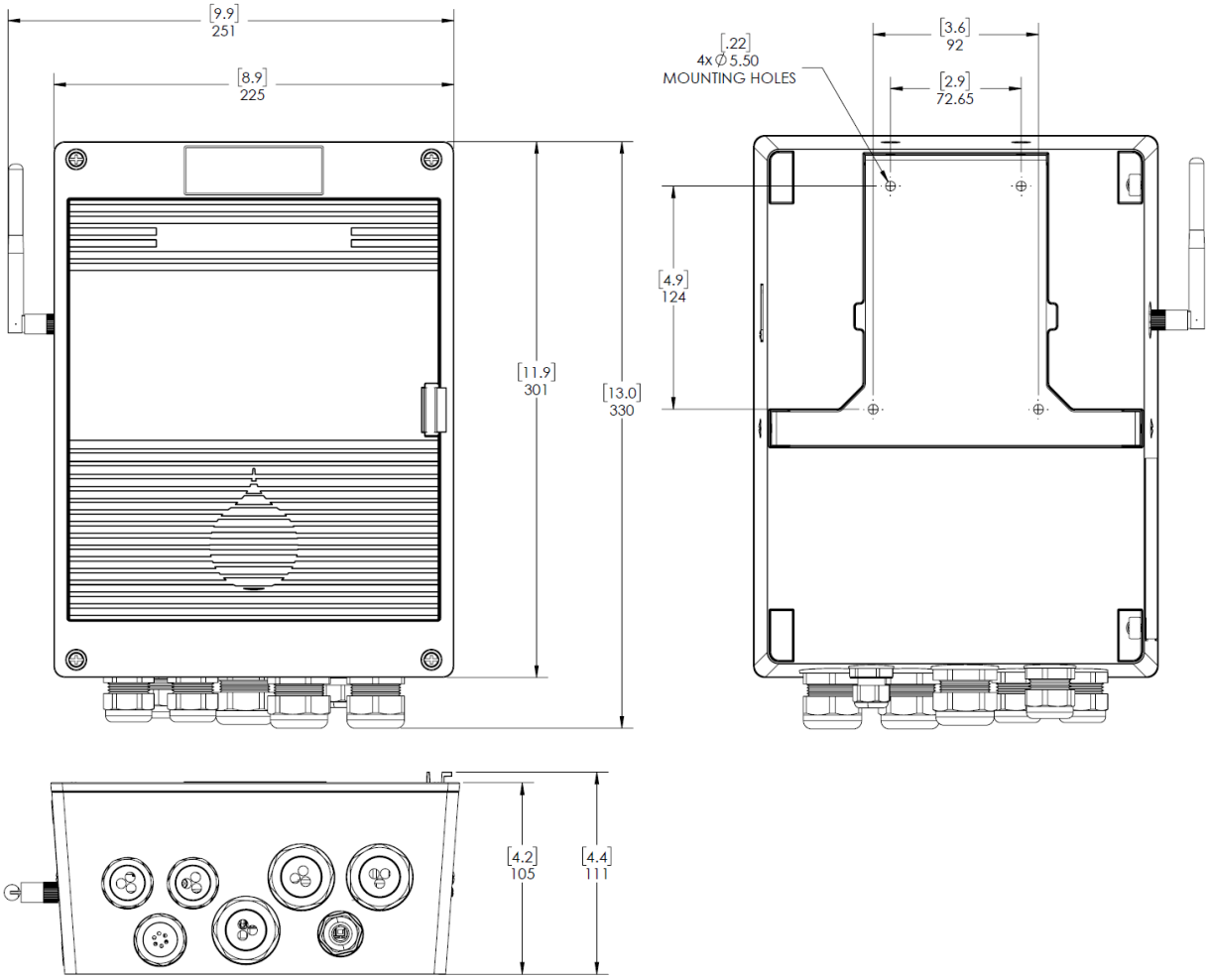


Figure 1: Controller Dimensions

2. Attach the mounting bracket to sheet metal or wood using the included screws. Screws for other surfaces can be used with the 5.5 mm (7/32”) through holes as long the screw head is less than 4 mm (5/32”) in height. M5 or 3/16” screws are recommended.

3. Once the mounting bracket has been securely fastened, attach the controller to the mounting bracket and secure with the four included Phillips screws on the top and sides of the controller. Refer to **Figure 2** for placement of screws.

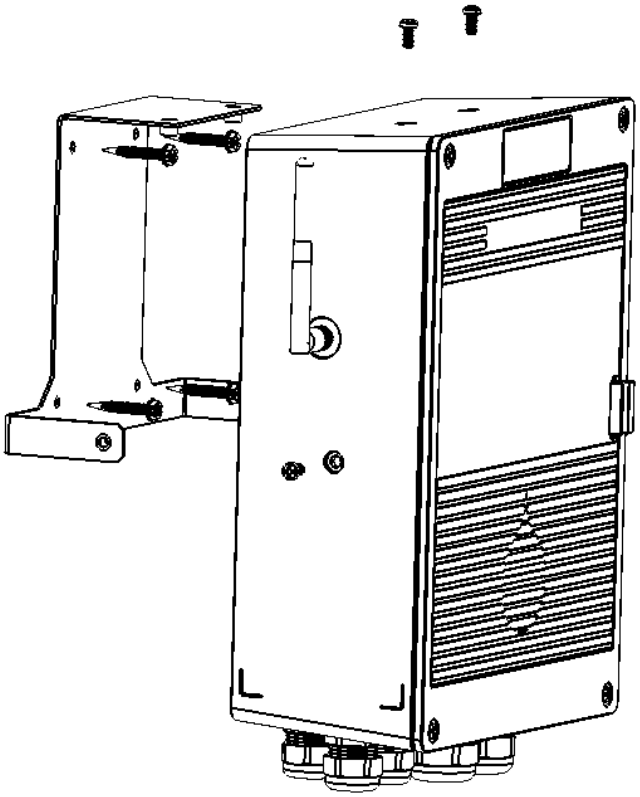


Figure 2: Controller Mounting Diagram

3.3 LMI Connect Antenna

Attach the included cellular antenna (56437) to the SMA Female connector on the left side of the unit. Tilt the antenna so that it is pointing upwards. LMI Connect can be activated at connect.lmipumps.com using the product serial number and LMI Connect ID that can be found in **System Settings** – Network Settings. An account can be created with the registration of a new device.

In challenging cellular reception environments, a 50 Ohm extension cable or amplified cellular antenna can be used with an SMA Male connector. Wilson Amplifiers manufactures a number of antennas and amplifiers with SMA Male connectors.

3.4 Inline Probe Installation

The LMI probes are shipped with a protective bottle or cover that may be filled with a storage solution. After removing the cover, rinse the electrode tip with distilled water.

Do not remove protective bottle for an extended period before installation. Allowing the probe to dry will reduce the useful life of the probes.

The LMI probes have ¾" NPT thread for inline installation. To simplify and ensure proper submersion of the probes, LMI provides a Flow Cell (56566) that is pre-engineered to

accommodate three probes and includes a sample valve. If more than one probe is used, remove the second and/or third ¾" NPT cap on the flow cell.

The Flow Switch Assembly (56568) includes a ¾" NPT adapter that must be glued into the PVC Tee. Attach the ¾" NPT adapter to the inlet or outlet of the flow cell prior to gluing. The flow switch may be mounted within a horizontal pipe or within a vertical pipe with an upward direction of flow.

Wrap each probe with no more than 3 wraps of Teflon tape, thread into the Flow Cell finger tight, and use a 7/8" wrench or pliers to tighten an additional 1/2 turn.

The Flow Cell is pre-configured for a landscape orientation with the probes inserting from the top, sample valve on the bottom, and inlet/outlet on the left or right. Refer to **Figure 3** for orientation.

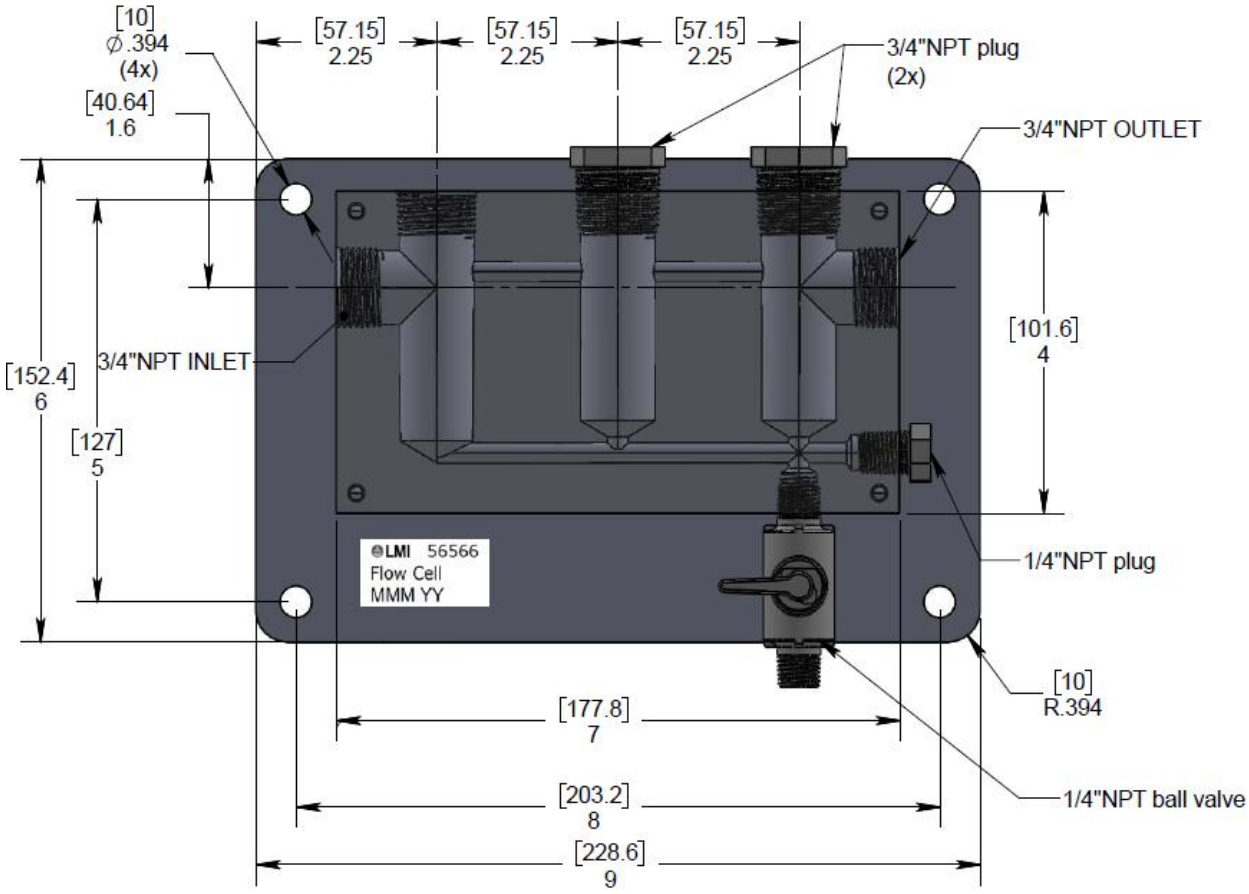


Figure 3: LMI Flow Cell

The Flow Cell can also be mounted in a portrait orientation by switching the location of the sample valve and the ¼" NPT plug. Remove the Phillips screw and handle on the sample valve to unscrew. In this configuration, the probes are inserted from the right, the sample valve is on the bottom, the inlet is on the bottom, and the outlet is on the top.

In the portrait orientation, the water must flow upwards through the Flow Cell.

3.5 LMI Mounting Panel (Optional)

A pre-engineered mounting panel as shown in **Figure 4** may be purchased to simplify and assist with the installation process. The mounting panel includes pre-drilled holes that are properly placed to allow for horizontal or vertical mounting depending on space constraints.

Figure 4: LMI Mounting Panel

3.6 Batch Tank / Submersed Probe Installation

The Liquitron 7000 Series Controller can be used for batch control in pH-Only and ORP-Only modes to control the effluent valve based on setpoint and time. This is commonly used for wastewater treatment to ensure proper pH or ORP and for processing applications. For Batch Mode, the Level Switch must be connected to the Flow Switch Input at J13 as shown in **Figure 18**.

For probes that are submersed, attach the probe firmly to the tank to prevent damage to the probe. Use the ¾" NPT threading on the top of the probe to attach an extension pipe that reaches above the fluid level. Seal the top of the extension pipe with a gland to protect the cable from water.

Probes must not be submersed without sealing the cable connection with an extension pipe.

Place the probe in a well-mixed area of the tank away from the chemical injection point to ensure accurate readings. Placing the probe too close to the injection point may cause spikes in readings that cause pumps to cycle on and off.

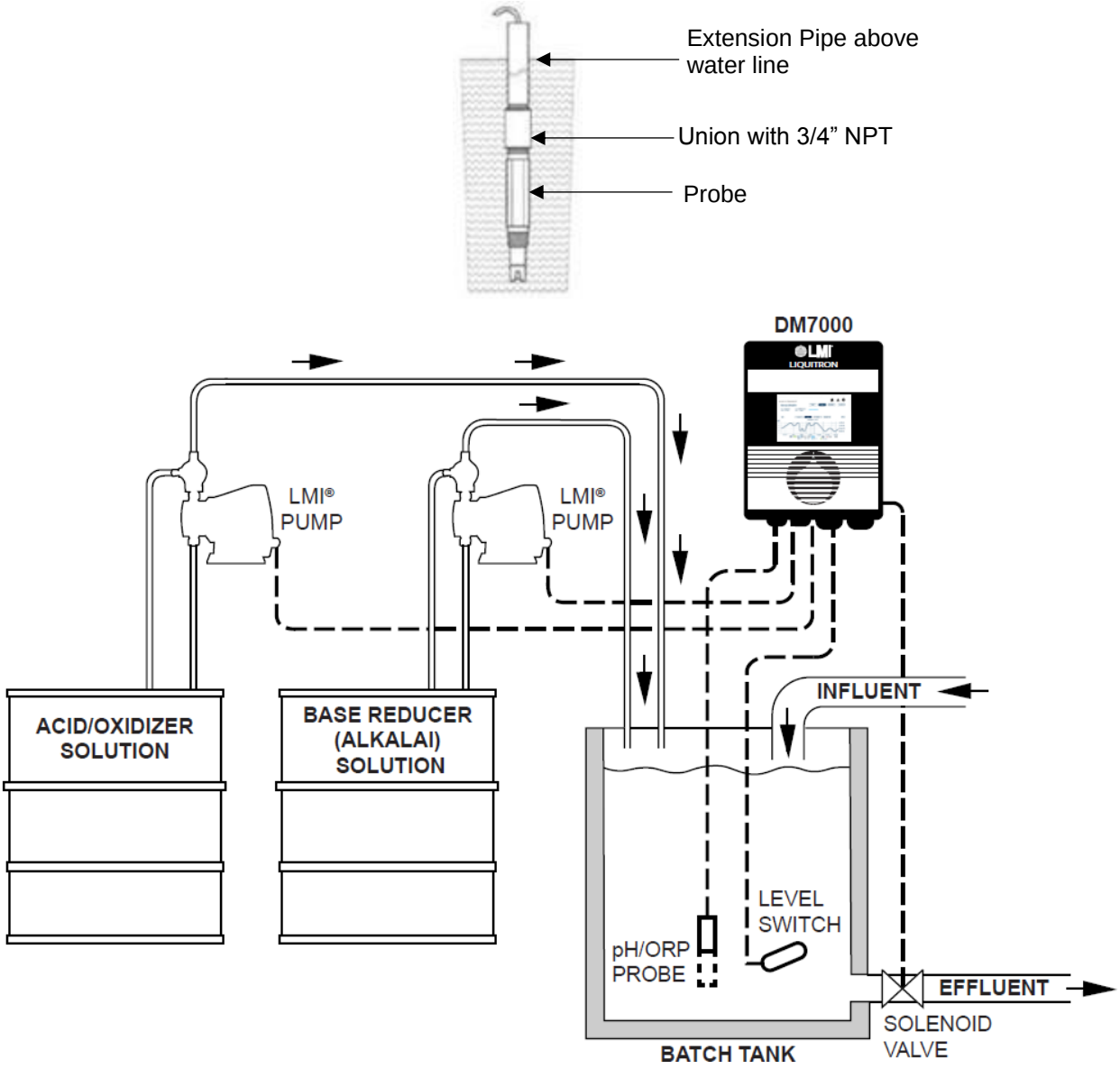


Figure 5: Submersed Probe Installation

3.7 Cooling Tower Installation

The Liquitron 7000 Series Controller should be installed based upon the recommended system diagram in **Figure 6**. A bypass loop for open recirculating water systems is the best method for monitoring and controlling conductivity. The probes must receive an active representative sample of system water.

A system shutoff valve is recommended for installation on each side of the flow cell to allow for system maintenance. A strainer is recommended to prevent debris from entering the flow cell.

Injection of water treatment chemicals can be done directly into the bypass line. Chemicals must be injected downstream of the probes to prevent spikes in measurements.

Installation of a flow switch on the bypass line is recommended to prevent dosing of chemicals into a stagnant line. Flowmeters can be installed on the makeup and/or blowdown lines to track water usage and control inhibitor feed.

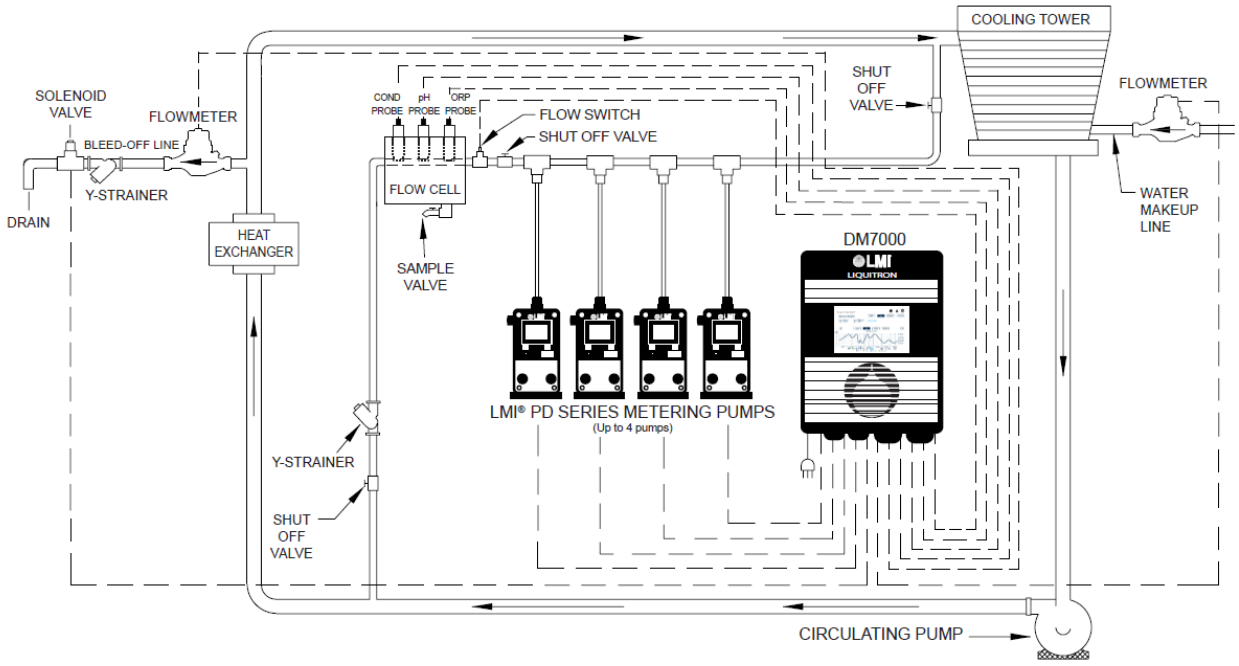


Figure 6: Cooling Tower Installation

3.8 Boiler Installation

The Liquitron 7000 Series Controller when used for boiler conductivity control can be set up in two different operating modes:

1. Continuous Sampling
2. Timed Sampling

The choice of which Boiler Sampling Mode to use is important. As a rule of thumb, if the blowdown requirement of the boiler is greater than 5,000 lbs/hr, the boiler may be continuously sampled. Since the boiler sample is sent to the drain and not returned to the system, continuously sampling a smaller (less than 5,000 lbs/hr blowdown requirement) boiler can result in excessive blowdown. Refer to **Figure 7** for Continuous Sampled Boiler System Diagram.

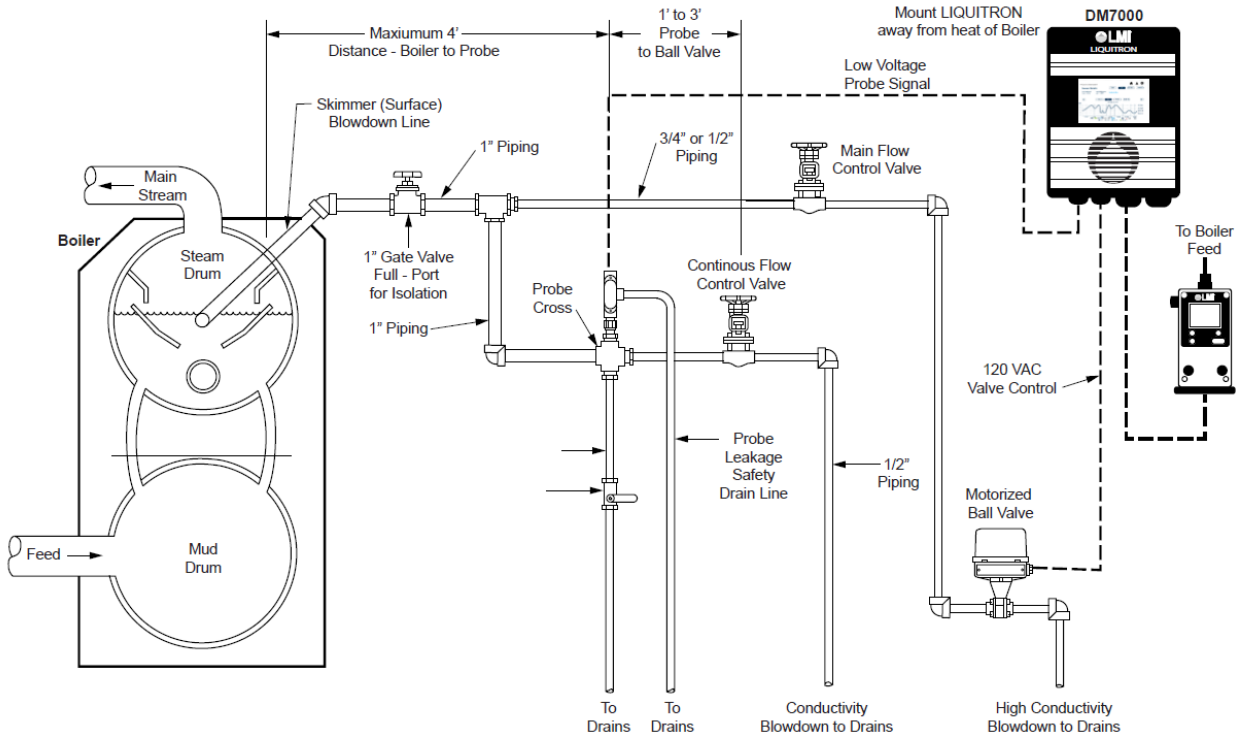


Figure 7: Continuous Sampling Boiler Installation

In timed sampling mode, the controller allows only periodic samples of boiler water to pass by the probe. If the sample is high in conductivity, the sampling period extends until the conductivity falls below preset levels. Once the conductivity is below the setpoint, including differential, the periodic sampling resumes at the preset intervals. Refer to Figure 8 for Continuous Sampled Boiler System Diagram.

If the blowdown requirement for your boiler is unknown, it can be approximated.

Data Required:

- H.P. = Boiler Horsepower
- % Condensate = % of Condensate Return to Boiler
- Cycles = Cycles of Concentration

Formula:

- $\text{H.P.} * 34.5 = \text{Steam Output} \left(\frac{\text{lbs}}{\text{hr}}\right)$
- $\text{Steam Output} \left(\frac{\text{lbs}}{\text{hr}}\right) * \left(1 - \frac{\%\ Condensate}{100\%}\right) = Makeup\ Req. \left(\frac{lbs}{hr}\right)$
- $Makeup\ Req. \left(\frac{lbs}{hr}\right) * \left(\frac{1}{Cycles - 1}\right) = Blowdown\ Req. \left(\frac{lbs}{hr}\right)$

Example:

- $200\ \text{H.P.} \times 34.5 = 6{,}900 \frac{\text{lbs}}{\text{hr}}\ \text{Steam Output}$
- $6{,}900 \frac{\text{lbs}}{\text{hr}}\ \text{Steam Output} * \left(1 - \frac{50\%}{100\%}\right) = 3{,}450 \frac{lbs}{hr}\ Makeup\ Req.$
- $3{,}450 \frac{lbs}{hr}\ Makeup\ Req. * \left(\frac{1}{4-1}\right) = 1{,}150 \frac{lbs}{hr} Blowdown\ Req.$

If metal piping is used, attach an earth ground connection near the conductivity probe.

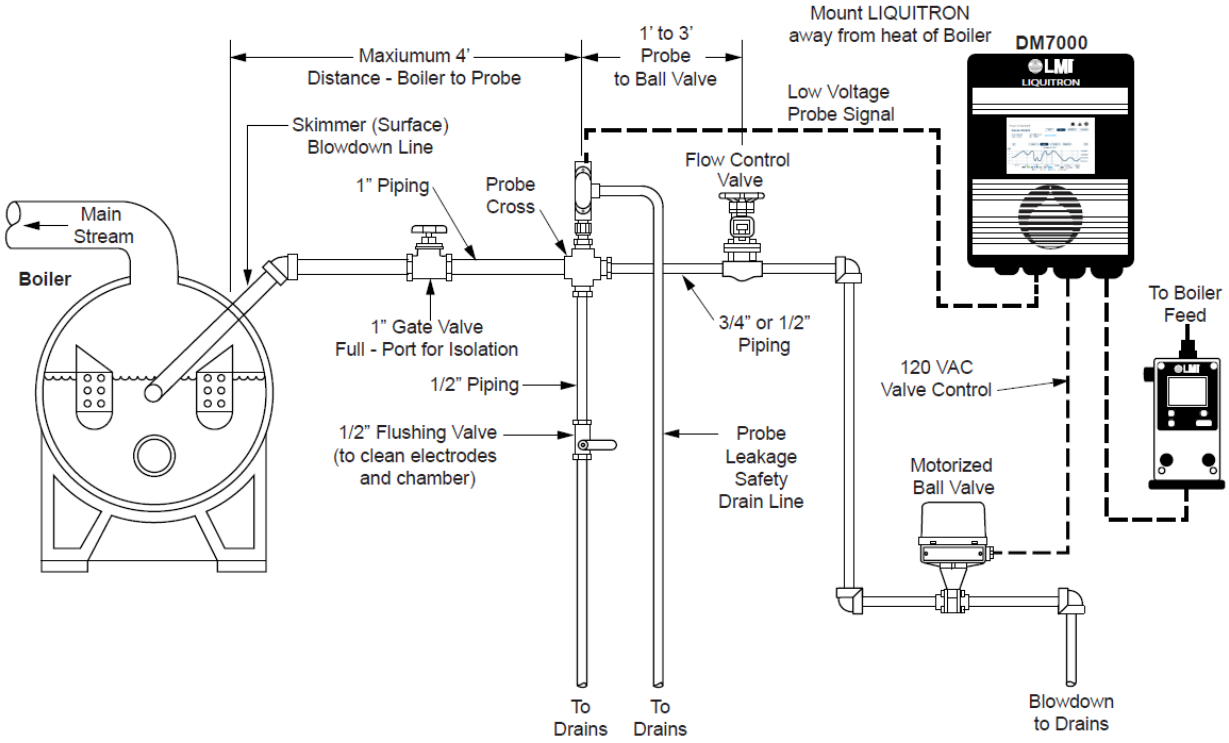


Figure 8: Timed Sample Boiler Installation

3.9 pH/ORP Inline Installation

The Liquitron 7000 Series Controller can be used for monitoring and controlling pH and ORP in an inline installation as shown in **Figure 9**. The injection point for the chemical should be a sufficient distance upstream from the Flow Cell with probes to allow for chemicals to be adequately mixed.

Installation of a flow switch is recommended to prevent dosing of chemicals into a stagnant line.

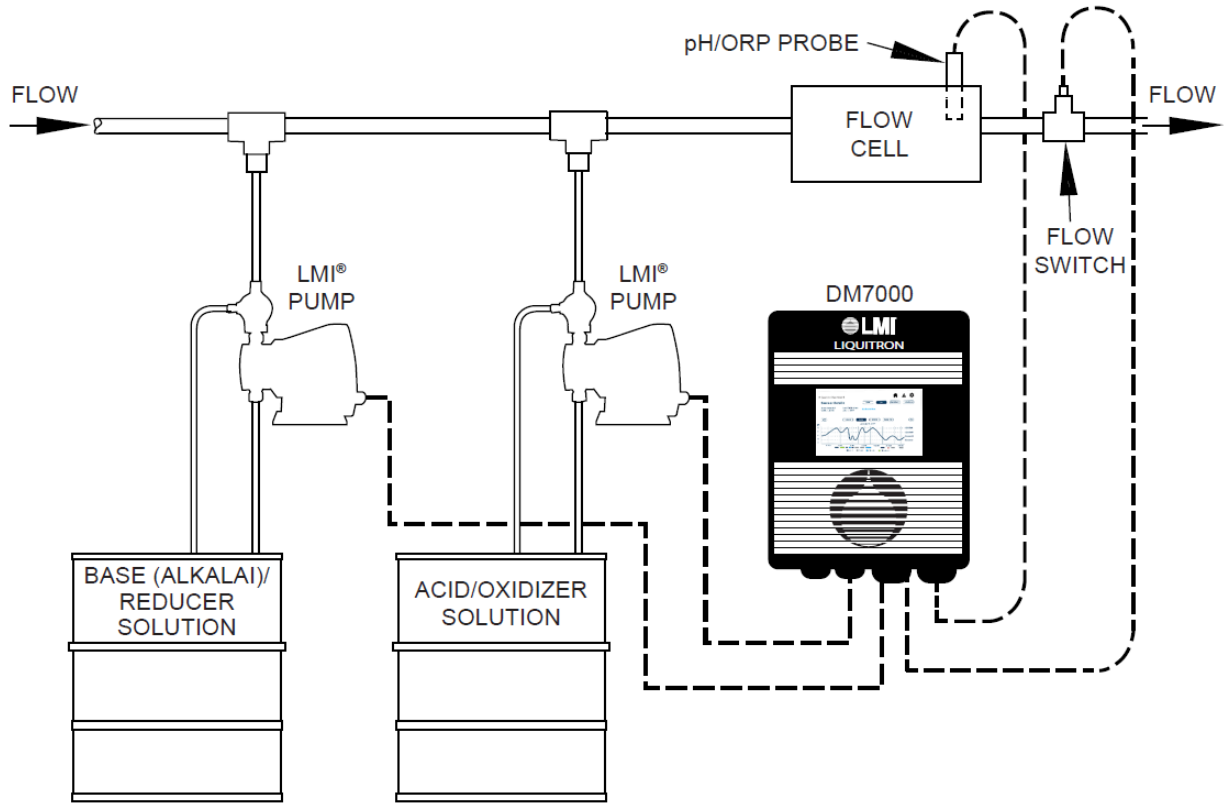


Figure 9: pH/ORP Inline Installation

3.10 Wiring

To access the wiring connections inside of the controller:

WARNING: Disconnect power prior to removing the black lid to access the wiring terminals.

1. Remove the four (4) #1 Phillips screws on the corners of the controller until the springs raise the screws.
2. Lift and remove the black cover.
3. Loosen the external nut on the desired cable gland while holding the gland in place with a second wrench.
4. Remove the sealing dowel from the cable gland with the smallest diameter that will accommodate the cable.
5. Insert the cable through the cable gland.
6. Locate the appropriate terminal on **Figure 10.**
7. For low voltage terminals, press the button on the terminal block and insert the wire so that the insulation is not clamped. For high voltage terminals, use a small Phillips or Flathead screwdriver to tighten the screw after inserting the wire.
8. Tug lightly on the wire to ensure proper insertion.
9. Verify any unused holes have dowel plugs in place and tighten external nut on cable gland.

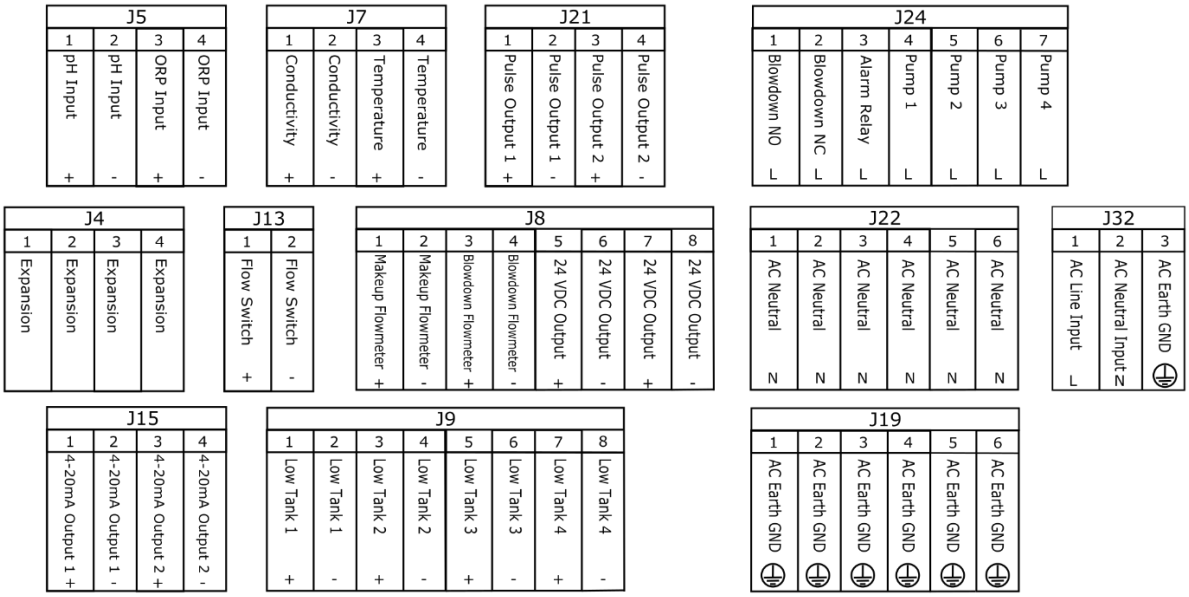


Figure 10: Complete Wiring Terminal Diagram

3.10.1 Power Input

When using a prewired unit, a 6-foot power cord with the appropriate connector is included and wired to terminal block J32. When using a hardwired installation, insert the power supply cable through the single cable gland and attach the wires to J32 as follows:

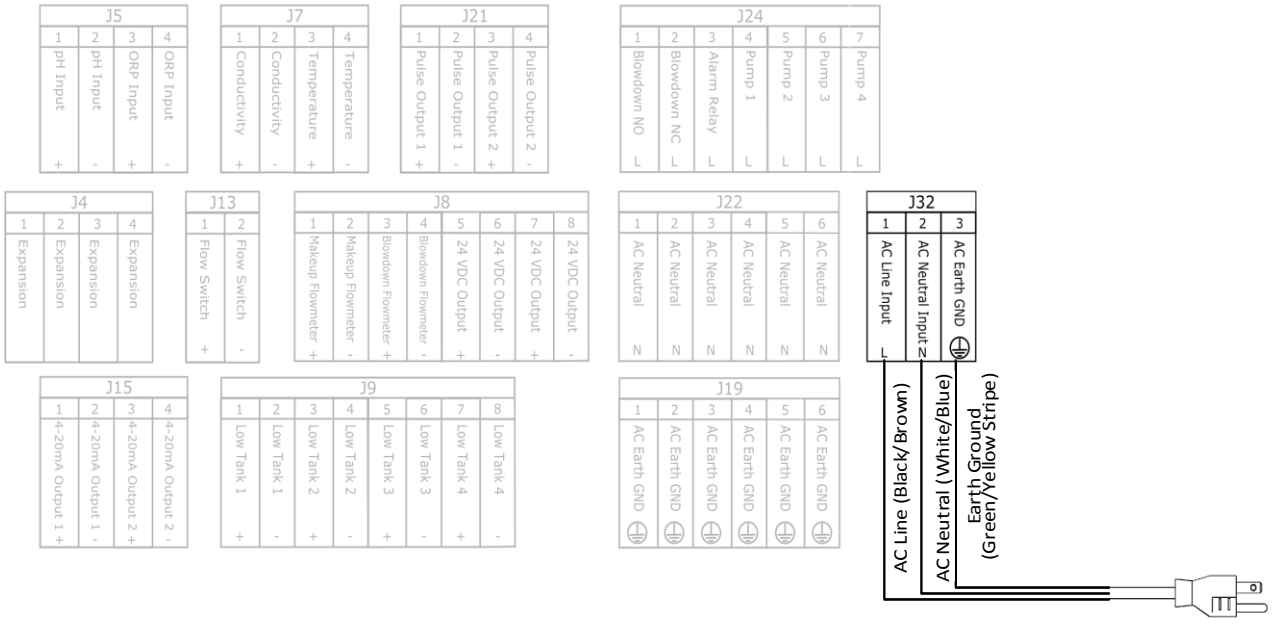


Figure 11: Power Input Wiring Diagram

To reduce the risk of electrical shock, the controller must be plugged into a grounded outlet with ratings conforming to the specifications on the data nameplate. It must be connected to a viable ground circuit.

3.10.2 On/Off Pump Output

The controller switches the input supply voltage to the pump output when chemical injection is required. When using a prewired unit, four (4) 6-inch power output pigtails with the appropriate connectors are included and wired to terminal blocks J24, J22, and J19. The pump power cords can be attached directly to the output pigtail.

When using a hardwired installation, insert the power cable for each pump through the cable glands and attach the wires as follows, repeating with pumps 2, 3 and 4 as required:

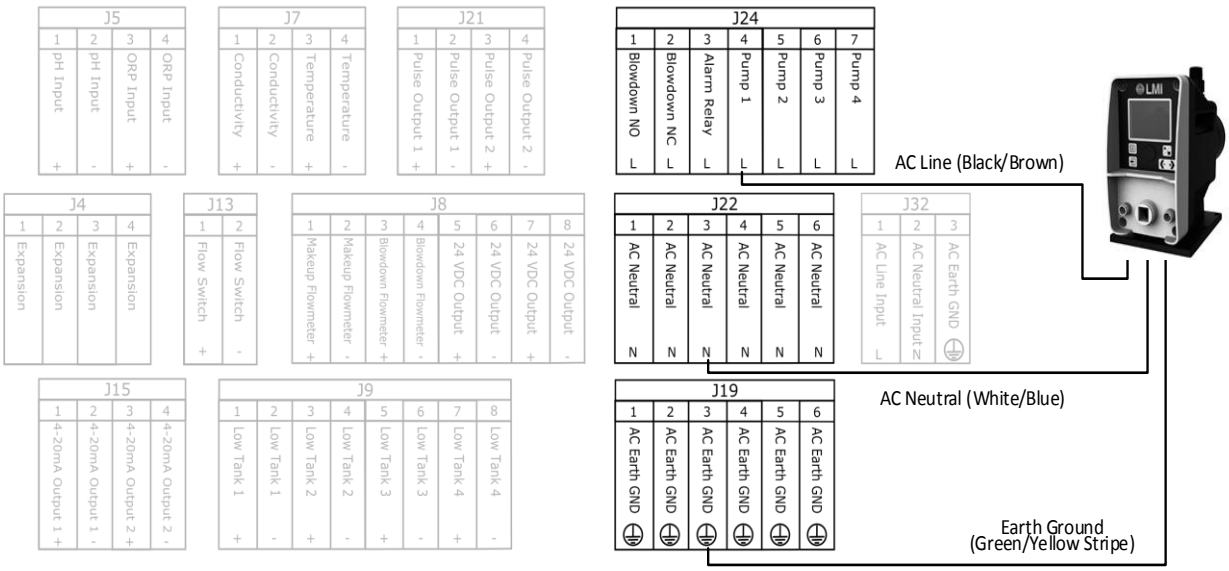


Figure 12: Pump Power Output Wiring Diagram

3.10.3 Proportional Pump Output

The controller provides two pulse outputs that can be used for proportional pump controller with either pH or ORP.

To use proportional control, the pumps must be connected to the appropriate relays. The pulse output 1 will provide the pulse for the pump assigned to Relay 1. Pulse Output 2 provides the pulse for the pump assigned to Relay 2. Make sure the Acid and Base or Reducer and Oxidizer pumps are assigned to Relays 1 and 2.

Proportional control is enabled in **Application Settings** – Pulse Pacing.

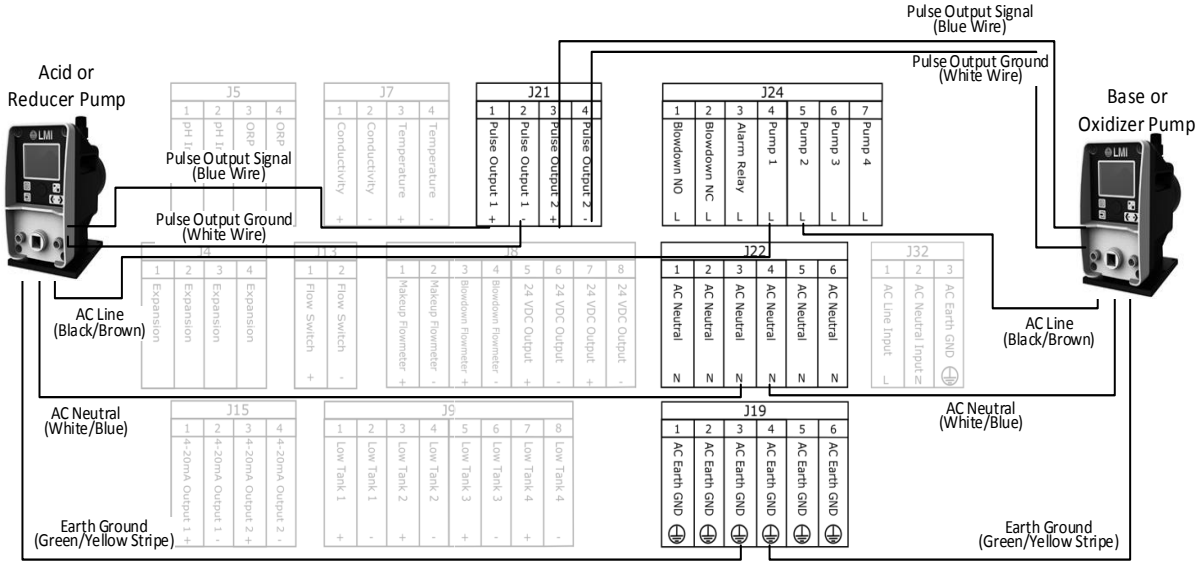


Figure 13: Proportional Pump Wiring Diagram

3.10.4 External Alarm Relay Power Output

The controller switches the input supply voltage to the External Alarm Relay when an alarm is active that is configured to trigger the external alarm. Adjust the External Alarm settings in Application Settings – External Alarms. Insert the power cable for the alarm through the cable gland and attach the wires as follows:

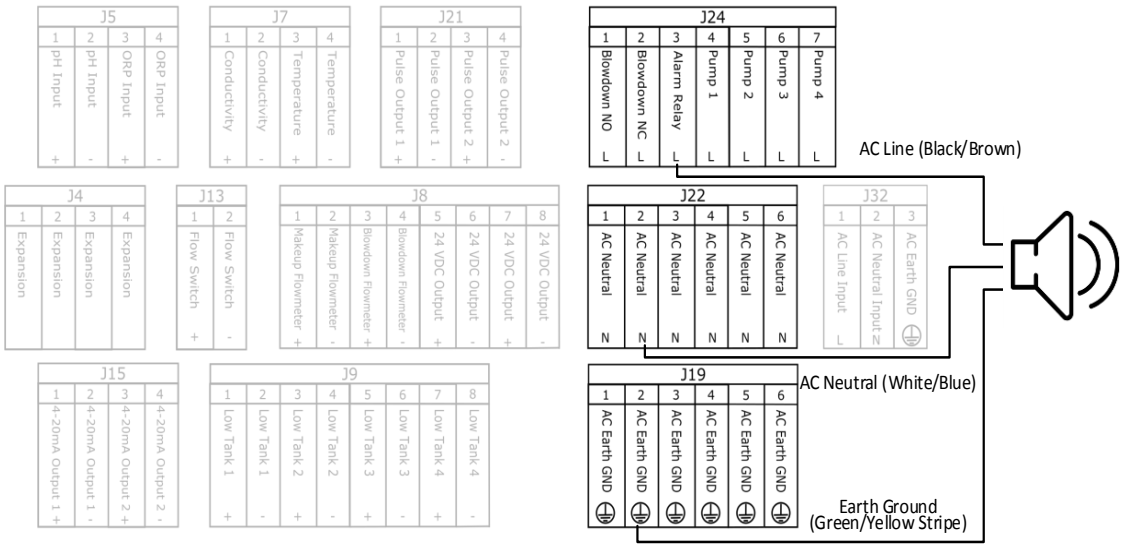


Figure 14: External Alarm Relay Wiring Diagram

If a dry contact alarm is used, an external relay such as a Functional Devices RIB-U1C can be used.

3.10.5 Blowdown Valve Power Output

The controller provides a Single Pole Double Throw Relay that switches the input supply voltage to the Blowdown Valve when required. For a motorized ball valve, both normally open and normally closed connections can be used as shown in **Figure 15**. Insert the power cable for the valve through the cable gland and attach the wires as follows:

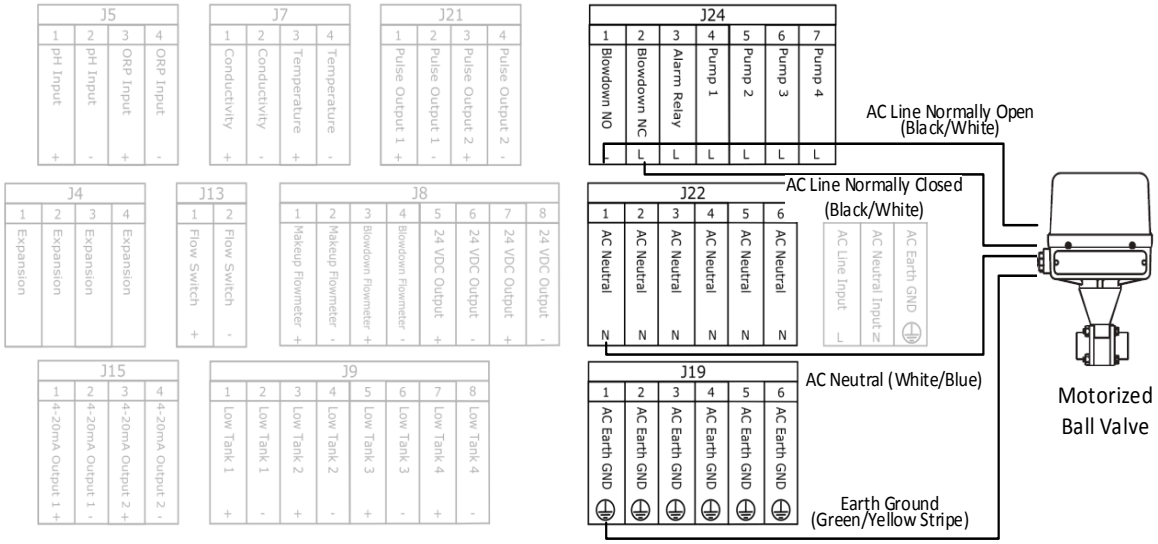


Figure 15: Motorized Blowdown Valve Wiring Diagram

For a solenoid valve, connect to the normally open or normally closed line connection as shown in **Figure 16**.

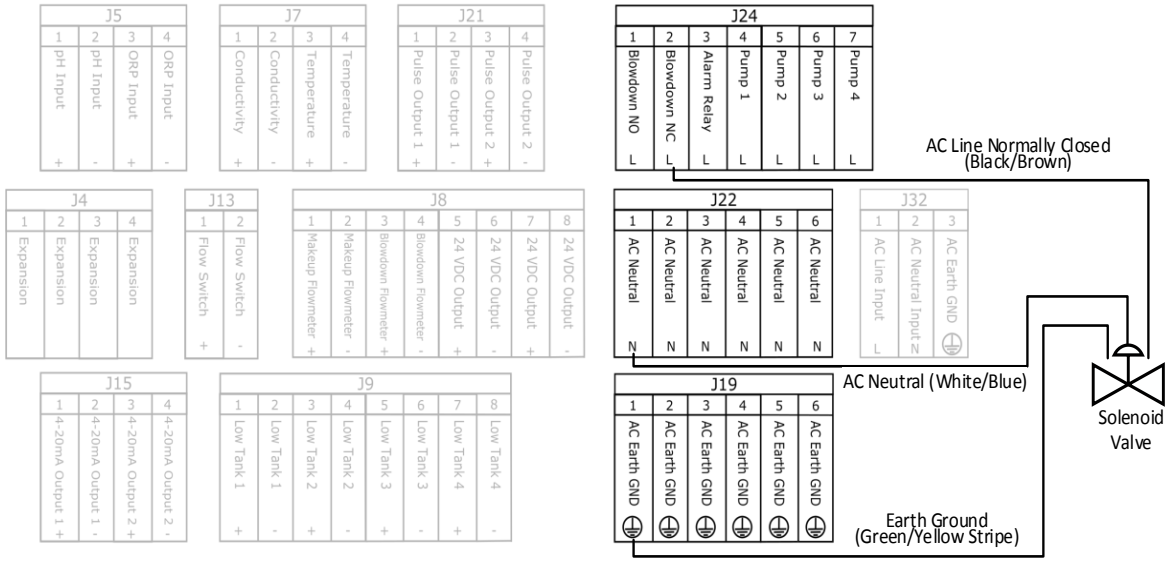


Figure 16: Solenoid Blowdown Valve Wiring Diagram

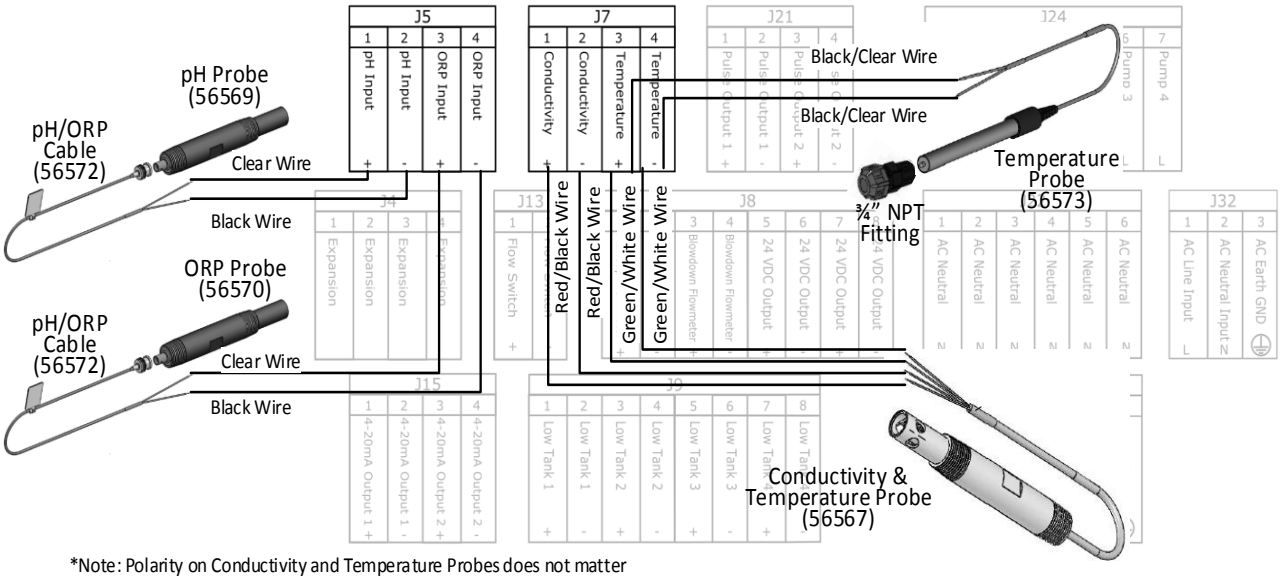
The Blowdown Valve connection is also used for the effluent valve in a batch mode installation. Refer to **Section 3.6** for Batch Mode details.

3.10.6 Probe Input

The controller can accept one pH input. Connect a pH/ORP coaxial cable (56572) to the BNC connector on the pH probe (56569), insert the tinned leads through the cable gland, and attach to the appropriate terminal. To take advantage of temperature compensation for pH measurement, connect a conductivity probe (56567) with built in temperature probe or a stand-alone temperature probe (56573). The stand-alone temperature probe includes a ¾" NPT gland fitting for use with the Flow Cell (56566).

The controller can accept one ORP input. Connect a pH/ORP coaxial cable (56572) to the BNC connector on the ORP probe (56570), insert the tinned leads through the cable gland, and attach to the appropriate terminal.

The controller can accept one conductivity probe input. The LMI conductivity probe (56567) has a cell constant of K = 1.0. The controller can also accept a conductivity probe with a cell constant of K = 1.5. Use Application Settings – Conductivity Cell Constant to select K = 1.5 if required. Insert the tinned leads through the cable gland and attach to the appropriate terminal.



*Note: Polarity on Conductivity and Temperature Probes does not matter

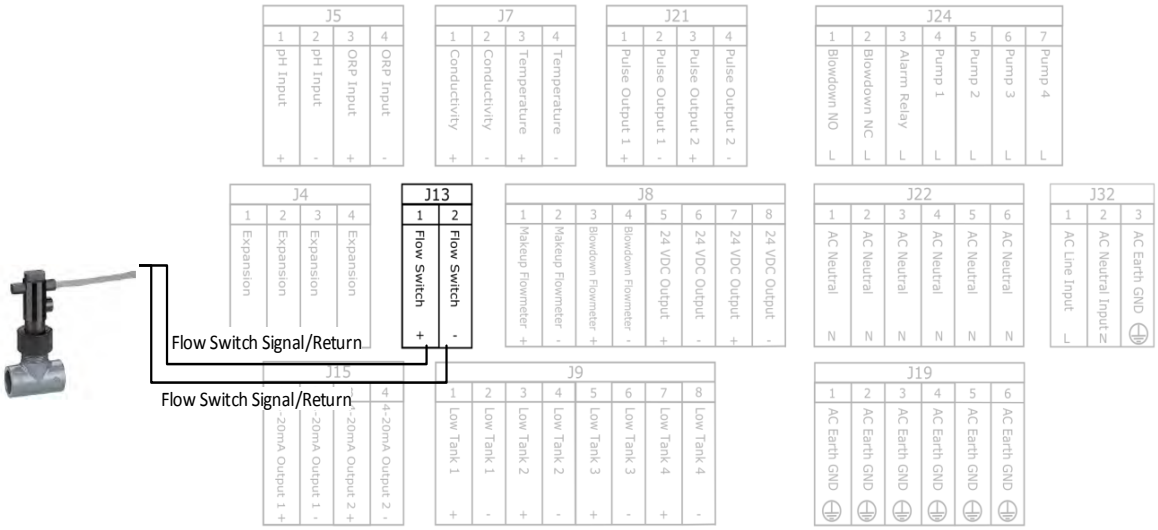
Figure 17: Probe Wiring Diagram

3.10.7 Flow Switch Input

The controller supplies 24V on the Flow Switch connection and consumes 4mA when closed. The controller will not engage chemical feed pumps in automatic control mode while the flow switch input is OPEN. The controller is delivered with a jumper on J13 to support installations without a flow switch.

If no flow switch is used, ensure jumper is in place in the Flow Switch terminal block J13.

To install the flow switch, remove the jumper on J13, insert the flow switch cable through the cable gland, and attach the wires as follows:



*Note: Polarity on Flow Switch signal/return does not matter

Figure 18: Flow Switch Wiring Diagram

When installing the LMI Flow Switch (56568) into the tee assembly, be sure to glue the straight thread adapter into the branch of the tee. This adapter is for the flow switch. The NPT fitting can be threaded into the LMI Flow Cell (56566) and glued into a through connection on the tee.

For pH-Only and ORP-Only Applications with a Batch Mode Installation, connect the level switch to the Flow Switch Input.

To use an alternative flow switch, PLC, or other triggering mechanism, refer to **Figure 19**.

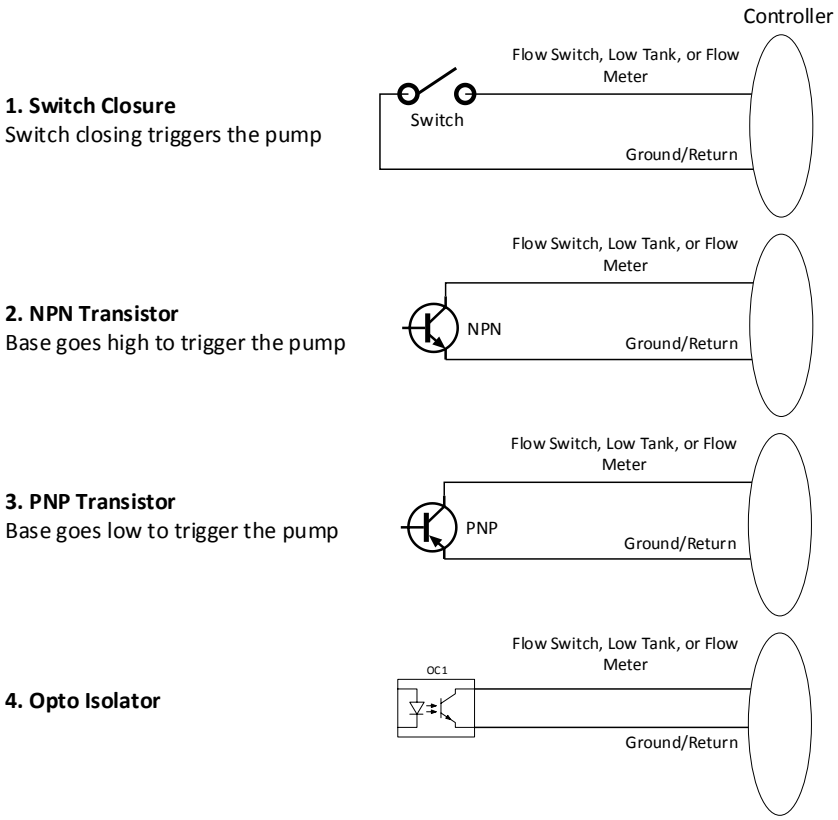
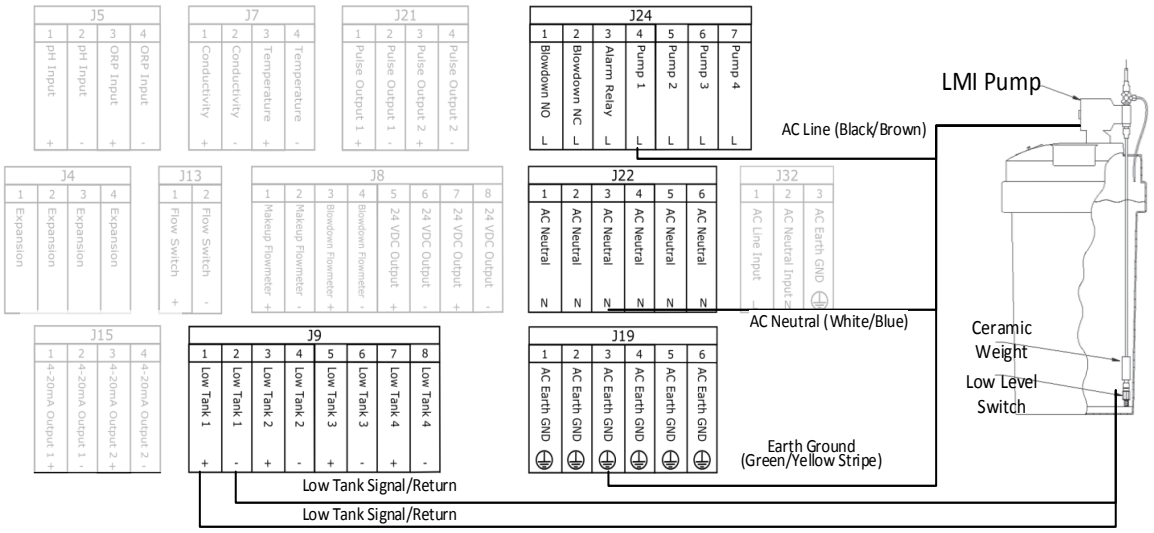


Figure 19: Methods of Externally Triggering Digital Inputs

3.10.8 Low Tank Input

The controller includes four (4) Low Tank Digital Inputs that generate an alarm when triggered. The inputs 1-4 correspond to the chemical pump assigned to the matching relay. The external alarm can be configured for Low Tank Alarms in **Application Settings** - External Alarms. The Low Tank Inputs are normally open and a short indicates a low tank level. Place the low-level switch with a ceramic weight at the desired height in the chemical tank. Be sure to mount the low-level float adequate distance above the empty level to provide sufficient warning to refill your tank before it becomes empty. Insert the Low Tank Sensor cables through the cable gland, and attach the wires as follows:



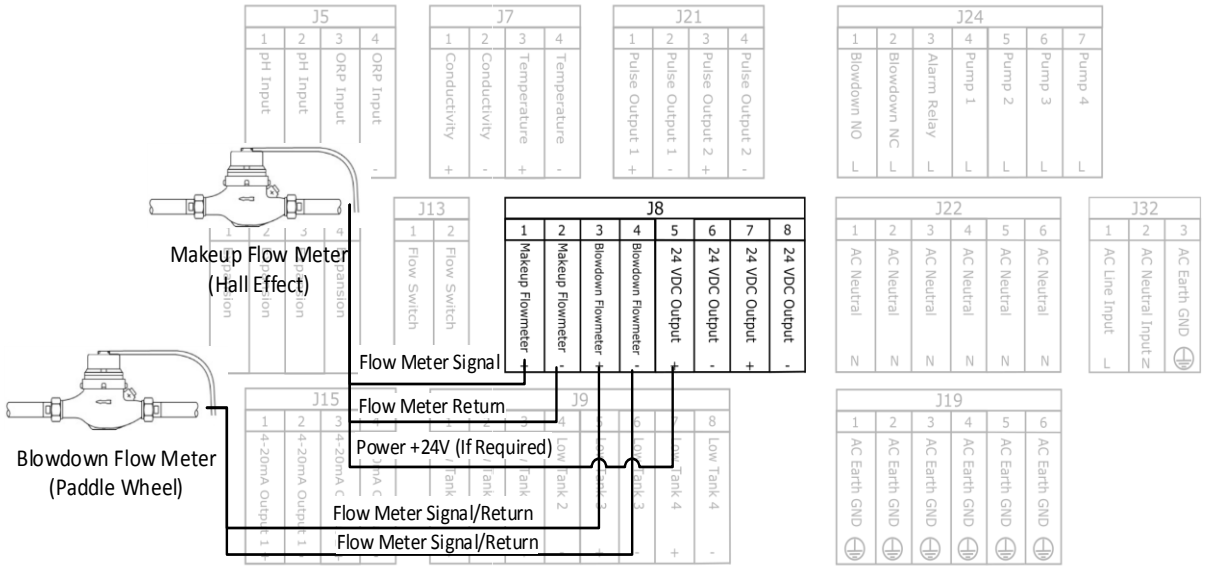
*Note: Polarity on Low Tank signal/return does not matter

Figure 20: Low Tank Input Wiring Diagram

Refer to **Figure 19** for other methods to trigger the Low Tank Inputs

3.10.9 Flow Meter Input

The controller includes separate Flow Meter Inputs for Make-up and Blowdown water. For use with a contacting or paddle wheel flow meter, the controller supplies 24V on the Flow Meter connection and will consume 4mA when closed. The controller provides two (2) 24 VDC power outputs that can be used to power a Hall Effect Flow Meter. The maximum current rating for these outputs is 100mA combined. A signal pull-up resistor is not required. Insert the flow meter cables through the cable gland, and attach the wires as shown in **Figure 21**.



*Note: Polarity on Paddle Wheel signal/return does not matter

Figure 21: Flow Meter Wiring Diagram

3.10.10 Analog 4-20 mA Output

The controller includes two (2) Analog 4-20 mA Outputs that can be configured in **Application Settings** – Analog Outputs to indicate any available sensor value at a user-defined scale. This can be used for a chart recorder or PLC. Insert the 4-20 mA cables through the cable gland, and attach the wires as follows:

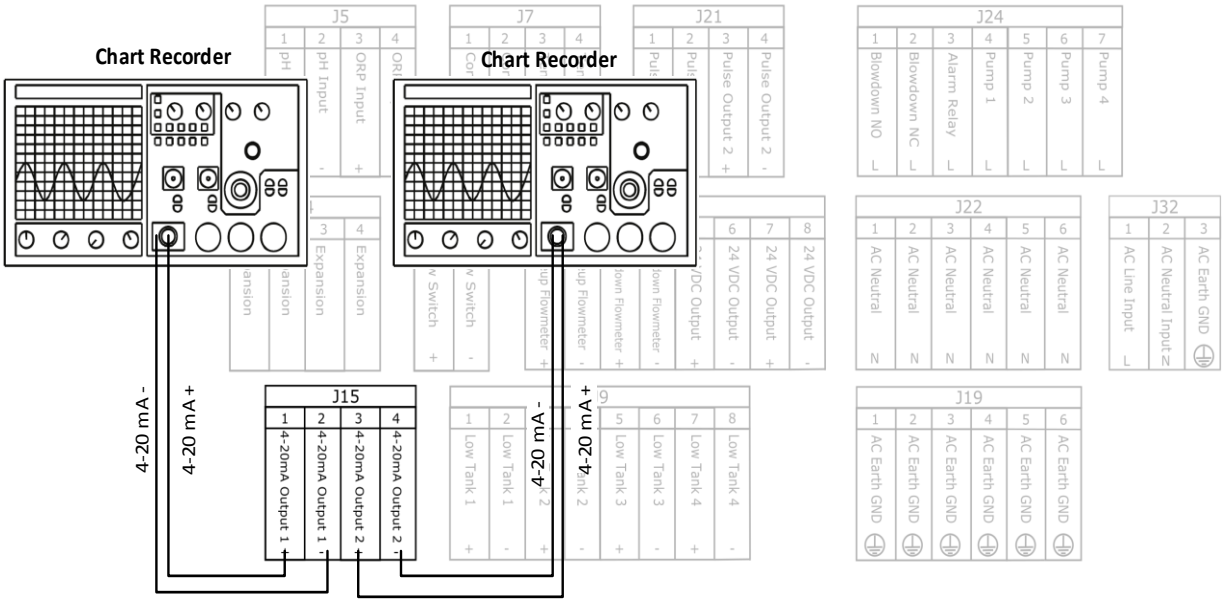


Figure 22: Analog Output Wiring Diagram

4.0 Operation

4.1 Dashboard

The LIQUITRON™ 7000 Series Controller includes a system dashboard that provides a snapshot of the health of the water process. All sensor values and control states are displayed. The dashboard also provides shortcuts to the primary features of the controller. Once the controller has been set up, the dashboard will be shown when power is applied.

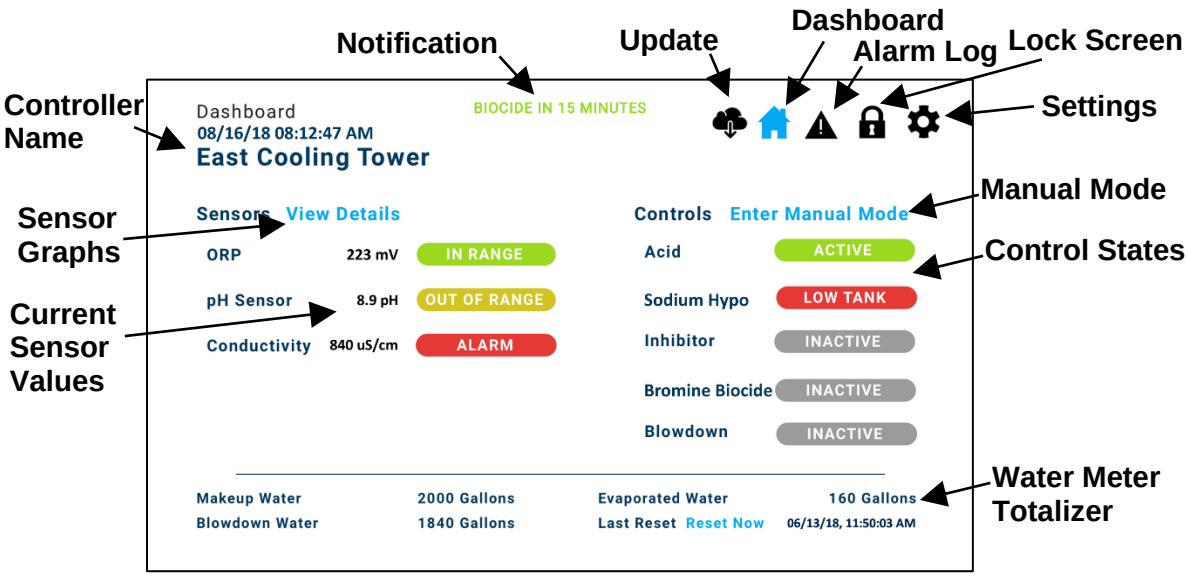


Figure 23: System Dashboard

The System Dashboard displays the controller custom name on the top. This can be modified in **System Settings** – Change Names.

Each sensor's current value is shown along with the status. The available options are In Range, Out of Range, Alarm, Disconnected, and Sensor Error. There is a shortcut to "View Details" to access the **Sensor Details** page with sensor graphs.

Each control is shown along with its status. The available options are Inactive, Active, and Low Tank. Select "Enter Manual Mode" to manually control the relays.

The Water Meter Totalizer section displays the volume for each flow meter since the last reset. If both flow meters are configured, the evaporated water is shown. Use the Reset Now button to reset the water totals.

The notification area displays an active alarm or upcoming timed event. If there are multiple items active, they are cycled to display each one at a time.

The top right portion of the dashboard provides shortcuts to install a software update (only shown if a new update has been downloaded with LMI Connect), Dashboard, Lock Screen, Alarm Log, and Settings.

4.2 Manual Mode

In Manual Mode, all control algorithms are disabled. This mode can be used for:

- system testing
- priming pumps
- manually dosing chemical
- manually bleeding the system

Tap the “Back to Dashboard”, “Return to Automatic Mode”, or Home icon to enable automatic control algorithms.

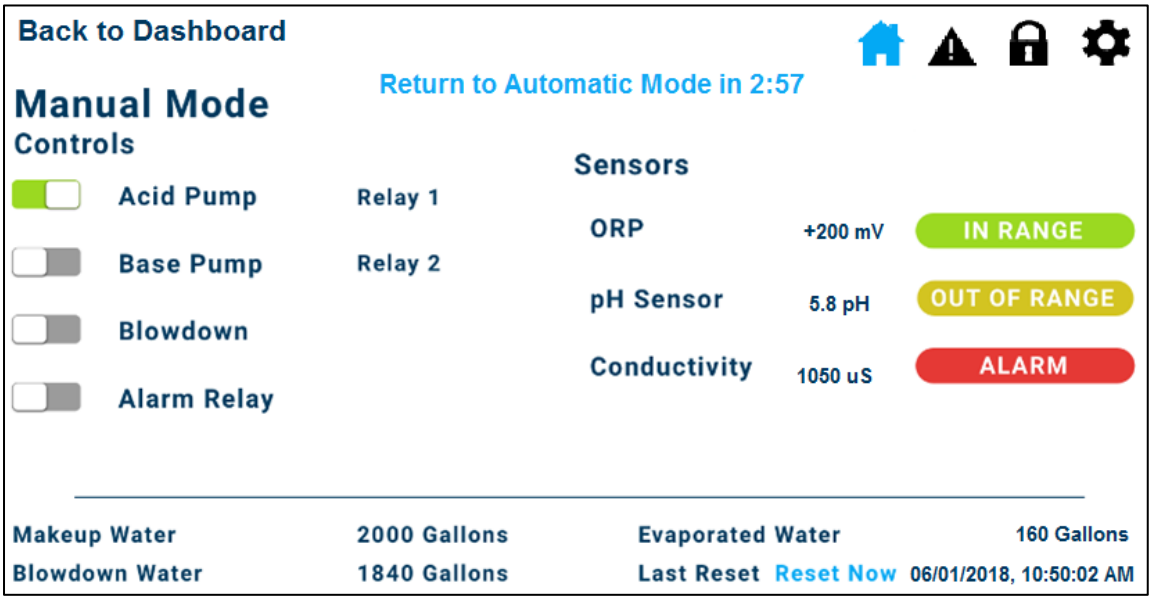


Figure 24: Manual Mode

The controls are displayed along with their status. Use the toggle sliders to enable the controls. The associated relay is also displayed. The rest of the page is similar to the main dashboard.

The controller remains in Manual Mode for 3 minutes of inactivity and then return to Automatic Mode. Any interaction will extend the timer.

4.3 Sensor Details

The controller will log sensor values and control states at a one-minute interval. These are stored in the internal memory for at least one year. Sensor graphs can be shown by selecting “View Details” on the Dashboard.

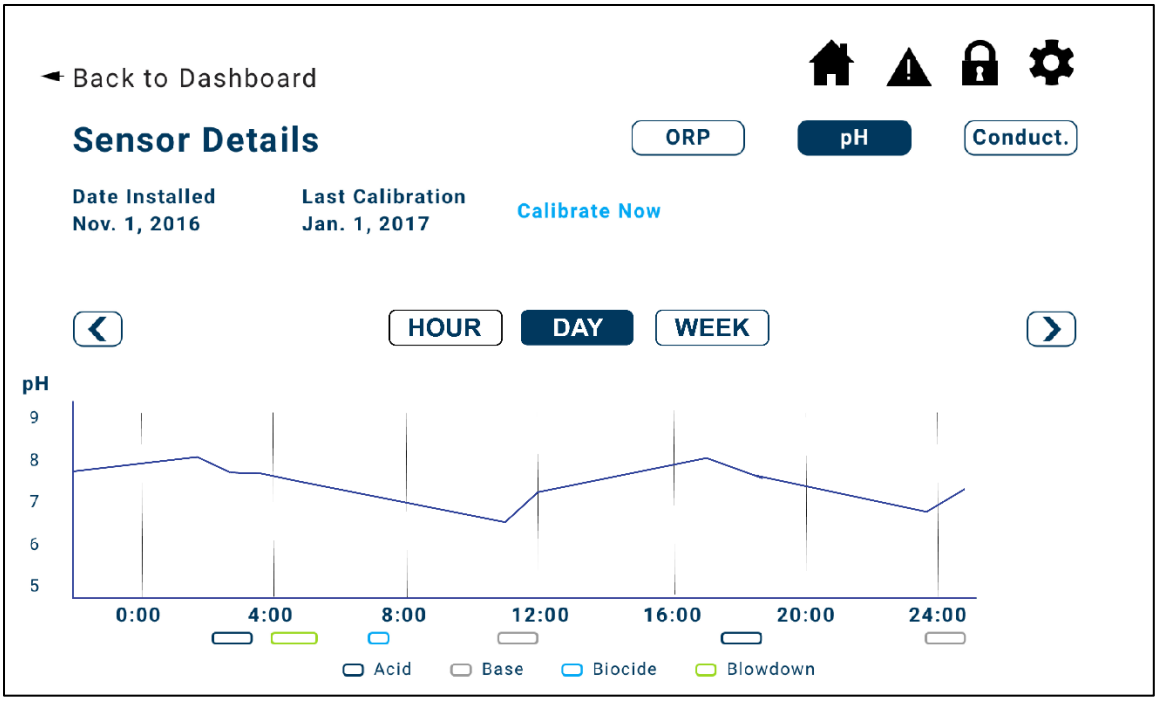


Figure 25: Sensor Details

Select the sensor and the time span for the graph. Use the left and right arrows to shift to the previous hour, day, or week.

A timeline of control is shown on a horizontal bar beneath the sensor graph. This matches the timescale of the sensor graph and allows for visual correlation of control actions and system response.

The sensor installation and last calibration dates are shown. There is a shortcut to calibrate the sensor that is currently shown in the graph. Sensor calibration can also be done through Application Settings – Calibrate Sensors.

4.4 Alarm Log

The controller will log alarms and display them in the alarm log. The alarm log can be exported to a USB drive in the Advanced Settings.

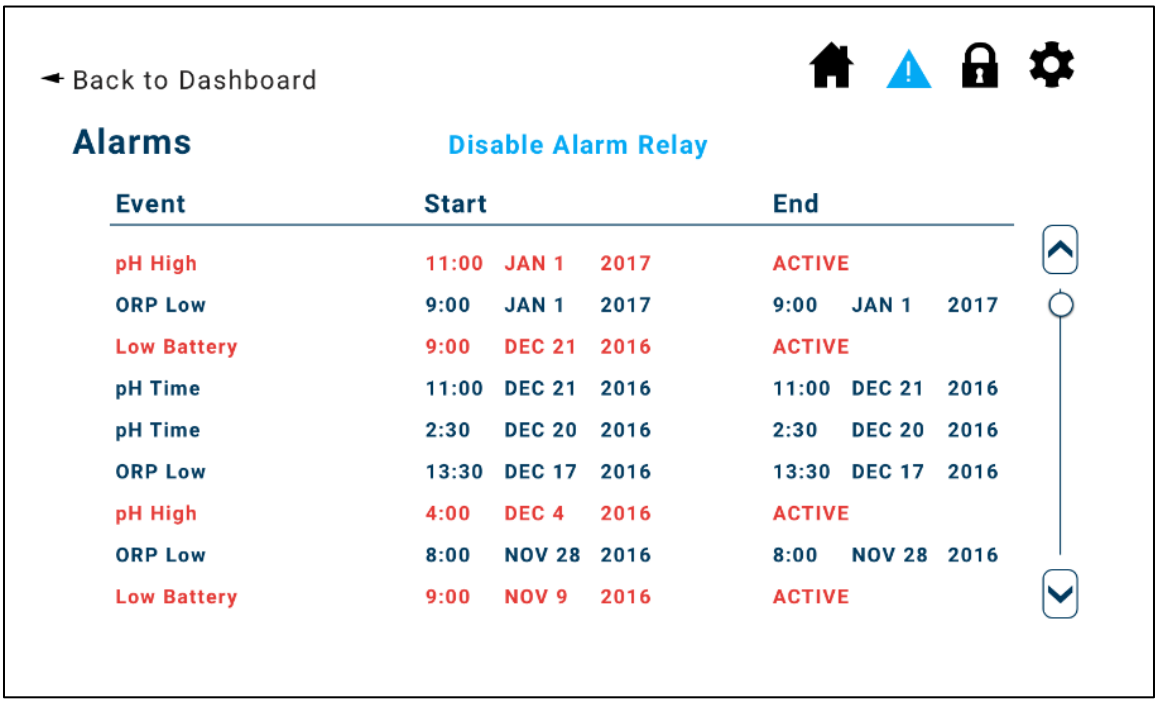


Figure 26: Alarm Log

The alarms are displayed in reverse chronological order with the most recent alarms at the top of the list. Active alarms are shown in red font.

A shortcut to disable the alarm relay displays if the external alarm relay is activated.

4.5 Software Configuration

The LIQUITRON™ 7000 Series Controller includes an Initial Setup Wizard that begins automatically when the unit is first powered on. The Setup Wizard takes you through the configuration process and includes informational text. Additional settings and changes to these settings can be made later through the **Application Summary Screen**.

Begin by selecting the language, setting the date and time, selecting a unit of measure, and entering a custom name for this controller. If you have a saved profile from another controller, select “Clone from USB”. Otherwise, select “New” to begin a new setup.

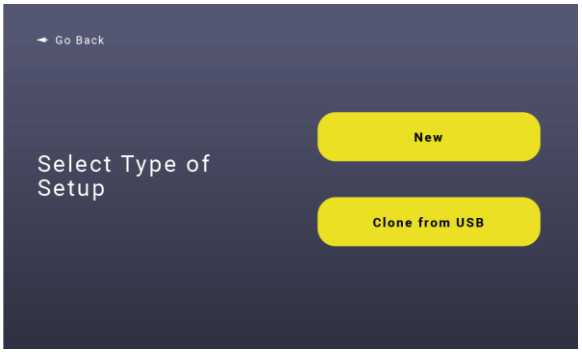


Figure 27: Setup Type

For a new setup, select the application used for this controller. The various applications simplify the controller setup operation by removing unused features.

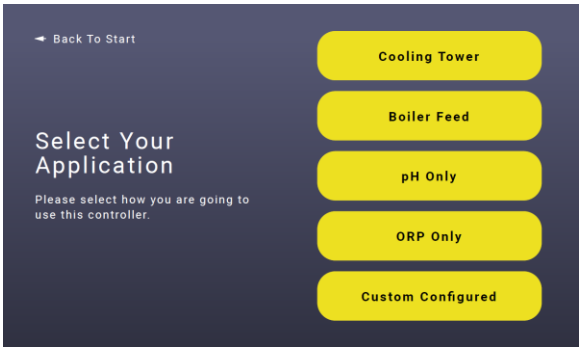


Figure 28: Application Selection

The following list indicate the functionality of each application. If there is doubt, the "Custom Configured" application provides full functionality.

Table 4: Application Functionality

	Cooling Tower	Boiler Feed	pH Only	ORP Only	Custom Configured
Conductivity Measurement	●	●	-	-	○
Blowdown Control	●	●	-	-	○
Timed / Continuous Sampling	-	●	-	-	-
Inhibitor Feed	○	○	-	-	○
pH Measurement	○	○	●	-	○
Acid Control	○	○	○	-	○
Base Control	-	-	○	-	○
Inline / Batch Control	-	-	●	-	-
ORP Measurement	○	-	-	●	○
Oxidizer Control	-	-	-	○	○
Reducer Control	-	-	-	○	○
Oxidizing Biocide Control	○	-	-	-	○
Inline / Batch Control	-	-	-	●	-
Timed Biocides	○	-	-	-	○

● Required
○ Optional
\- Not Available

4.5.1 Conductivity Measurement

The conductivity setpoint is the target maximum conductivity level for the system. The blowdown valve is activated once the measured conductivity exceeds the setpoint. The blowdown valve will remain open until the conductivity level drops below the setpoint

minus differential. Ensure the differential is large enough to prevent rapid cycling of the valve.

The conductivity units for ppm or uS/cm can be selected on the Conductivity Setpoint screen.

By default, the controller is configured for a Conductivity Cell Constant of 1.0. If a 1.5 cell constant probe is used, access the Conductivity Cell Constant setting from the Application Settings Menu.

Refer to the **Section 3.8** Boiler Installation for details on selecting Timed or Continuous Sampling Mode. Only the Boiler Application will allow for Timed Sampling to be configured.

4.5.2 Inhibitor Feed

The controller supports four possible Inhibitor Feed Modes:

Water Meter Pulse: Pump output based on makeup flow meter input.	The number of Gallons (Liters) to trigger a pumping event.
	The length of time to run the Inhibitor Pump for each event.
Feed as % Bleed: Inhibitor Feed after Bleed	Percentage of the Bleed time to run the inhibitor pump. Inhibitor will be added when the bleed is completed.
	Max inhibitor run time.
Feed as % Time: Continuous feed output based on a repeating cycle timer.	Cycle Time.
	Percent of time to run inhibitor feed.
Feed & Bleed: Feed and Bleed simultaneously	Max inhibitor run time.

4.5.3 Biocide Control

The LIQUITRON™ 7000 Series Controller can control two (2) Biocide pumps with a combined total of 14 events. There are three methods of Biocide control:

1. **Timed Biocide Event**

   Deliver biocide based on a schedule with a fixed duration for each event. Each event is set to recur according to a 4-week cadence as follows:

Start Week	Set the event to occur in the current week, or in weeks 2, 3, or 4. If configured for current week with recurrence cycle of 4 weeks, the event will run in week 1, week 5, etc.
Weeks per Cycle	Set the number of weeks per cycle. Selecting 1 Week will cause the event to recur every week. 4 Weeks will cause the event to recur every four weeks.

Days of Week	Select the days of the week for the event to run.
Start Time	Select the time of day to start the event.
Pump Run Time	Select the duration to run the biocide pump.

Once the event is created, a schedule summary will display the days in which the event will occur. Events are color coded for the biocide pump. Select “Add More” to create additional events or select “Done” to finish.

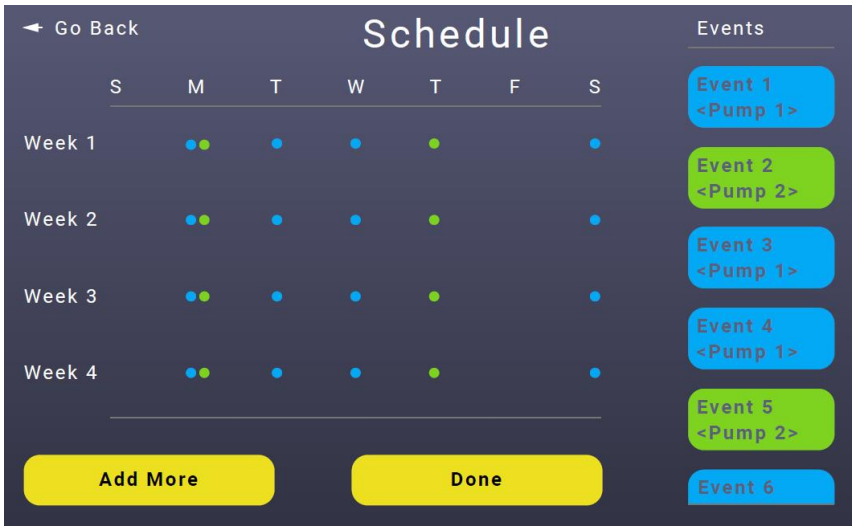


Figure 29: Biocide Schedule Summary

2. Continuous ORP Biocide

The Biocide 2 Pump can also be used for ORP control. This can be useful for controlling the concentration of oxidizing biocides such as chlorine or bromine. A Continuous Setpoint for ORP maintains a constant ORP. The Biocide 2 pump will engage if the ORP drops below the differential and run until the ORP measurement is above the setpoint.

3. Timed ORP Biocide

A Timed ORP Biocide Event can be used to periodically elevate the ORP of the system for a shock event. This is similar to a Timed Biocide Event, but rather than running the pump for a fixed duration, the controller elevates the ORP above the Setpoint and maintain this level for a defined duration. Enter an ORP setpoint, differential, and time to hold for this event. You will then be able to configure the schedule just as a timed event.

4.5.4 Biocide Lockout

Since it may be required to prevent blowdown for a period after a biocide has been added to the system, the controller allows for a lockout time to be configured for each biocide pump. This prevents the bleed from activating for the specified time in minutes.

4.5.5 Biocide Pre-bleed

To further prevent blowdown of biocide chemical, a pre-bleed option is available. This initiates a blowdown for either a fixed duration or until a pre-bleed conductivity setpoint is reached just before a biocide is added. The pre-bleed will begin at the start time of the event and delay the biocide addition.

4.5.6 pH Measurement

The pH Only Application allows for In-Line or Batch Mode pH control and can be configured for Acid Only, Base Only, or Both. The Cooling Tower and Boiler Application Modes allows for Acid control.

Acid Setpoint	The acid pump turns OFF at the acid setpoint for lowering pH
Acid Differential	The acid pump turns ON when the pH rises above the setpoint plus differential
Base Setpoint	The base pump turns OFF at the base setpoint for rising pH
Base Differential	The base pump turns ON when the pH lowers below the setpoint minus differential
In-Line / Batch Mode	Select Batch Mode to control an effluent valve based on level sensor and setpoint hold times.
Settling Time (Batch Mode Only)	Once the setpoint has been continuously maintained for the Settling Time, the Solenoid Valve (Blowdown Relay) opens.
Valve Time (Batch Mode Only)	The valve remains open until the Valve Time is reached, the sensor becomes out of range, or the batch tank is low.

To enable proportional control, access the Pulse Pacing option from the Application Settings Menu. For Batch Mode, the Level Switch must be connected to the Flow Switch Input at J13 as shown in **Figure 18**.

4.5.7 ORP Measurement

The ORP Only Application allows for In-Line or Batch Mode ORP control and can be configured for Reducer Only, Oxidizer Only, or Both. The Cooling Tower Application Mode allows for an Oxidizing Biocide to be controlled with the ORP sensor.

Reducer Setpoint	The Reducer pump turns OFF at the Reducer setpoint for lowering ORP
Reducer Differential	The Reducer pump turns ON when the ORP rises above the setpoint plus differential
Oxidizer Setpoint	The Oxidizer pump turns OFF at the Oxidizer setpoint for rising ORP
Oxidizer Differential	The Oxidizer pump turns ON when the ORP lowers below the setpoint minus differential
In-Line / Batch Mode	Select Batch Mode to control an effluent valve based on level sensor and setpoint hold times.

Settling Time (Batch Mode Only)	Once the setpoint has been continuously maintained for the Settling Time, the Solenoid Valve (Blowdown Relay) opens.
Valve Time (Batch Mode Only)	The valve remains open until the Valve Time is reached, the sensor becomes out of range, or the batch tank is low.

To enable proportional control, access the Pulse Pacing option from the Application Settings Menu. For Batch Mode, the Level Switch must be connected to the Flow Switch Input at J13 as shown in **Figure 18**.

4.5.8 Application Summary Screen

When the initial setup is complete, the Application Summary Screen will show a summary of all the settings. To make changes to any of the subsections, click on the appropriate Make Changes button. The Application Summary can be accessed later through the Settings Menu to make changes to these settings.

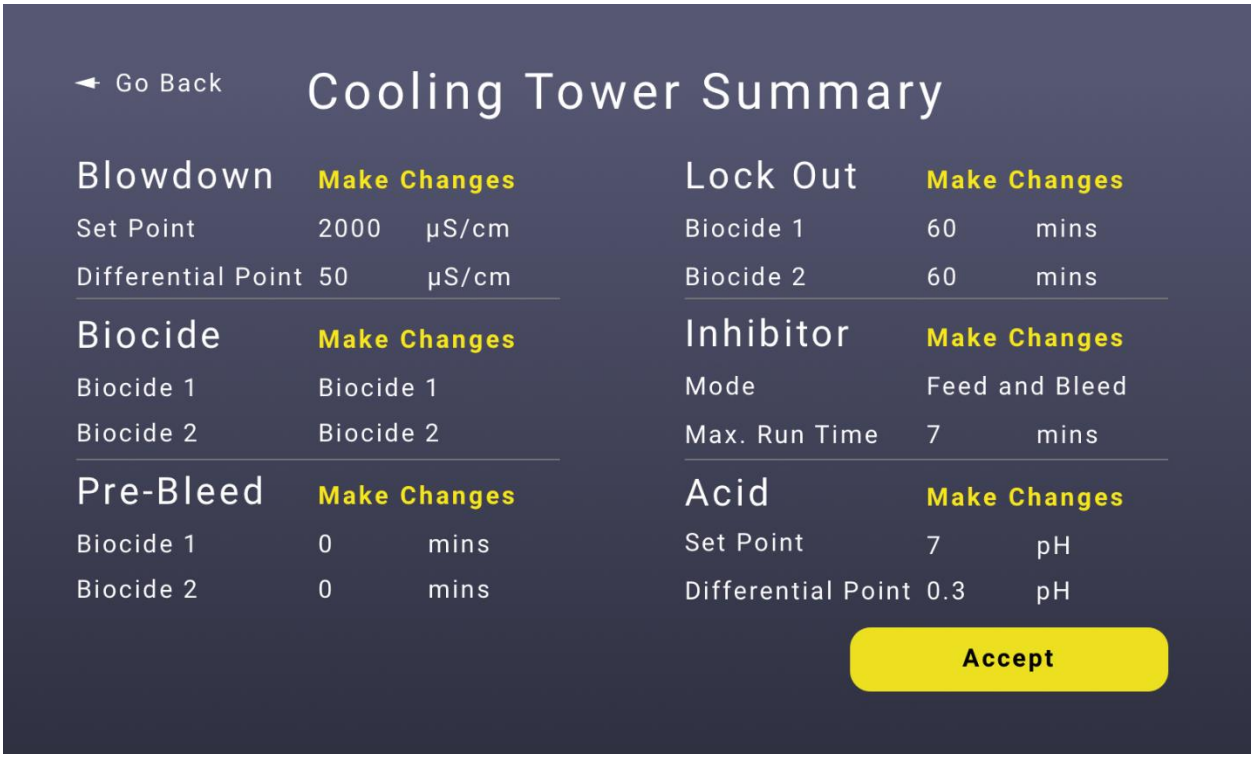


Figure 30: Application Summary Screen

4.5.9 Security Settings

The controller allows for three levels of local security that are locked with a four-digit PIN Code.

No Security	The No Security Option is activated by pressing the Skip – No Security button on the Create PIN Screen. The controller allows full local access.
Locked	The controller prompts for a PIN as soon as the controller powers on or comes out of timeout. The only accessible function is to disable the external alarm relay if it is currently active.

View Only	The controller allows for the Dashboard, Manual Mode, Sensor Details, and Alarm Log to be accessed. A PIN Code is required to access any settings pages.

4.5.10 LMI Connect

If your controller is equipped for LMI Connect smart monitoring service, attach the LMI Connect Antenna to the SMA Female connector on the side of the unit. The embedded cellular modem connects to the LMI Connect Cloud to determine activation status for this unit.

To activate your service, go to Settings / System Settings / Network Settings and perform one of the following:

- Go to connect.lmipumps.com to enter the serial number and LMI Connect ID shown on the Network Settings Page.
- Download the LMI Connect smartphone app to scan the QR code shown on the Network Settings Page.

Once activated, the Network Settings page displays the current subscription status and expiration date.

By default, LMI Connect allows remote monitoring but does not allow remote control. The Monitor Only mode provides notifications for alarms, remote access to view sensor values, and advanced reporting functionality. To change settings or control relays remotely, enable Monitor + Control Mode on the Network Settings Page. This can only be modified locally and there is no way to remotely enable remote control.

LMI Connect has implemented industry best practice data transport encryption with proprietary protocols. By activating Monitor + Control, you agree to accept responsibility for protecting the confidentiality of your user name, password, and other information necessary to access your account.

The LMI Connect Web Portal at connect.lmipumps.com provides access to your fleet dashboard where you can quickly see the health of all of your LMI Connect products. From the fleet dashboard, select an individual unit to view details, enable periodic report generation, and remotely control.

4.6 Settings Menu

Once the controller is set up, use the gear icon on the dashboard to access the settings menu.

4.6.1 View Application Summary

Access the Application Summary that was shown at the end of the initial setup. This is the entry point to make changes to anything that is displayed on the summary screen including setpoints, differentials, biocides, etc. For detailed changes to settings, use the other settings menus.

4.6.2 Application Settings

Calibration	A list of active sensors displays. Select a sensor to begin the calibration process. Refer to **Section 4.7** Probe Calibration for more details.
External Alarms	The external alarm relay can be optionally activated for any of the alarms. If the external alarm relay is disabled for an alarm, an alarm log entry is still created on the controller. As a default, High/Low Alarm, No Flow During Bleed, and Sensor Error are selected.
Flow Meter Constant	Set the Flow Meter Constant in pulses per gallon (liter). This can be 0.001 to 999.9. The default is 0.1 pulses per gallon (liter). Set the minimum pulse width in milliseconds. Pulses shorter than this are ignored. The Blowdown and Makeup Flow Meters are configured independently.
Conductivity Cell Constant	Set the Conductivity Cell Constant to 1.0 or 1.5 to match the conductivity probe. The default is 1.0.
Analog Outputs	The analog outputs can be configured for any sensor value. Select the output, sensor, and the desired sensor values that should correspond to 4 mA and 20 mA.
High/Low Alarms	Set the high and low alarm levels for each sensor. The defaults are based on setpoint and differential.
Pulse Pacing	Pulse Pacing can be used for proportional control of pH or ORP.
	The pulse output 1 always corresponds to the pump assigned to relay 1 and the pulse output 2 always corresponds to the pump assigned to relay 2.
	Tap a point on the plot to enter the desired pulse rate in pulses per minute. The points are on each end of the scale and at the setpoints.
Time Out of Range	Set a time threshold to trigger an alarm when sensor parameter has been out of range for an extended period. The default is 15 mins.
Max Run Time	Set the max run time which includes the continuous time the blowdown valve or pump relays can be active. The default is 60 mins.
	When the maximum time is exceeded, the system disables all relays, generate an alarm, and enter manual mode.

4.6.3 System Settings

Date/Time	Set the date and time for the system. Toggle between 12 hour and 24 hour time display.
Remove or Change PIN	Remove/Change PIN and security level
Custom Names	Change the names of the controller and chemical pumps
System Information	Display product name, serial number, and version information
Network Settings	If the LMI Connect Subscription has not been activated, display information on how to activate.
	If the LMI Connect Subscription is Active, display subscription status and expiration, cellular reception level, and serial number.
	Enable/Disable Remote Control. If Remote Control has not been enabled from the local settings, LMI Connect does not have the ability to control the unit.
Language	Change the language

Units	Change the units
Display Timeout	Set the amount of inactivity time for the display to timeout. If the locked security mode is selected, the PIN is required after timeout. The default is 5 mins.
Display Brightness	Set the brightness of the display backlight. The default is 80%.

4.6.4 Advanced Settings

Update Firmware	Update the firmware on the controller.
	If LMI Connect is active, the controller automatically downloads the update files. Access the Update Firmware Screen and select LMI Connect.
	To update with a USB drive, 1. Download the files from http://support.lmipumps.com and place them on a USB drive in a folder called Upgrade. 2. Insert the drive to the controller and navigate to Settings - Advanced Settings - Update Firmware – USB. 3. Select the file named "rbins.tgz" to update the display board. 4. This process takes approximately two minutes. The unit will cycle power and reboot when completed. 5. Navigate to Settings - Advanced Settings - Update Firmware – USB. 6. Select the file ending in ".bin" to update the mainboard with the sensor inputs. This process takes approximately five minutes and notify when completed.
Export Profile	Export configuration to a USB drive. This configuration can be cloned/imported onto another controller or used for technical support. The profile is saved into a folder named as the controller name in a csv format.
Factory Reset	Return the controller to default factory settings. This will delete all logs and configuration data from the unit. There is no undo for this function. A Factory Reset is required to change applications (i.e. from Cooling Tower to Custom Config).
Change Setup	Make major changes to the current setup within an application. If Skip was selected in the initial setup for inhibitor, biocides, or acid, the Change Setup will restart the setup wizard. Current settings will be stored and logs is preserved.
Export Logs	Export data logs, alarm logs, and error logs to a USB drive. Select the data range for the export.
Clone Profile	Import a saved profile from another controller. The file saved must be named as <text>_Profile_<text>.csv and be in the correct csv format to be recognized.
Calibrate Touchscreen	If the touch interface is offset, recalibrate the touchscreen. The unit cycles power and present a series of white screens with a red target. Tap each target to complete recalibration.

4.7 Probe Calibration

The controller will have a factory calibration stored for each sensor. To calibrate the probe in the operating environment, access the calibration screen from the Application Settings Menu and select the appropriate sensor. Alternatively, press Calibrate Sensor on the Sensor Details page to calibrate the sensor that is currently shown in the sensor plot.

The installation and last calibration date is recorded and displayed on the Sensor Details page. When calibrating, select New to reset the sensor installation date or Existing to calibrate an existing sensor. This maintains the installation date and update the last calibration date.

4.7.1 pH Calibration

The pH sensor can be calibrated with a one-point, two-point, or three-point calibration.

To perform a wet calibration:

1. Remove the probe from the flow cell.
2. Rinse the probe in distilled water and place in a calibration buffer near 4.0 pH or 10.0 pH.
3. Enter the pH of the buffer solution used and select Next.
4. Wait for the probe to stabilize.
5. Enter the temperature of the probe.

To perform a one-point calibration, select Skip to proceed to the calibration summary screen. This uses the entered point and assume 0V for 7 pH.

To proceed with a two or three-point calibration:

1. Rinse the probe in Distilled water and place in a calibration buffer near 7.0 pH.
2. Enter the pH of the buffer solution used and select Next.
3. Wait for the probe to stabilize.
4. Enter the temperature of the probe.

To perform a two-point calibration, select Skip to proceed to the calibration summary screen. This uses a single slope and offset for the full pH range.

To proceed with a three-point calibration:

1. Rinse the probe in Distilled water and place in a calibration buffer near 4.0 pH or 10.0 pH. The buffers can be done in the order 4, 7, 10 or 10, 7, 4.
2. Select Next and wait for the probe to stabilize.
3. Enter the pH of the buffer solution and the temperature of the probe.

This uses separate calibration equations above and below the second calibration point.

To perform a one-point calibration without removing the probe from the system:

Take a sample of water from the sample valve:

1. Use an external pH meter to measure the pH of the sample.
2. Enter the measured pH of the sample water and select Next.
3. Wait for the probe to stabilize and enter the temperature of the probe.

4.7.2 ORP Calibration

The ORP sensor can be calibrated with a one-point or two-point calibration.

To perform a wet calibration:

1. Remove the probe from the flow cell.
2. Rinse the probe in distilled water and place in a calibration buffer.
3. Enter the ORP value of the buffer solution and select Next
4. Wait for the probe to stabilize.

To perform a one-point calibration, select Skip to proceed to the calibration summary screen.

To proceed with a two-point calibration, rinse the probe in Distilled water and place in a second calibration buffer. Enter the ORP value of the buffer solution. Select Next and wait for the probe to stabilize.

Table 5: ORP Values for pH Buffers with Quinhydrone

pH Buffer	Expected ORP Reading
pH 7.0 Buffer	86 +/-20 mV
pH 4.0 Buffer	175 +/-20mV

To perform a one-point calibration without removing the probe from the system:

1. Take a sample of water from the sample valve.
2. Use an external ORP meter to measure the ORP of the sample.
3. Enter the measured ORP of the sample water.
4. Press Next and wait for the probe to stabilize.

4.7.3 Conductivity Calibration

The conductivity sensor can be calibrated with a one-point calibration.

To perform a wet calibration:

1. Remove the probe from the flow cell.
2. Rinse the probe in distilled water and place in a calibration buffer that is close to the conductivity level of the system.
3. Enter the conductivity of the buffer solution and select Next.
4. Wait for the probe to stabilize and enter the temperature of the probe.

Table 6: Standard Conductivity of Buffer Solution

Standard Conductivity of 0.01 M KCl	
Temperature ºC	**Expected Conductivity µS/cm**
0	776
5	896
10	1020
15	1147
16	1173
17	1199
18	1225
19	1251
20	1278
21	1305
22	1332
23	1359
24	1386
25	1413

To calibrate without removing the probe from the system:

1. Take a sample of water from the sample valve.
2. Use an external conductivity meter to measure the conductivity of the sample.
3. Enter the measured conductivity of the sample water and select Next.
4. Wait for the probe to stabilize and enter the temperature of the probe.

5.0 Spare Parts Replacement and Routine Maintenance

5.1 pH Probe Maintenance

The pH probe should always be kept wet. Allowing the probe to dry will permanently damage the probe. The probe should be replaced approximately once per year.

Contamination of the sensing element often results in slow response and inaccurate readings. Clean the element by one of the following procedures about once per month or more often if slowed response is observed:

1. Organic Oil and Grease Films: Wash electrode tip in a liquid detergent and water.
2. Protein Exposure: Soak the electrode tip in acidic pepsin for 5 minutes.
3. If the previous cleaning procedures fail to restore response, soak the electrode in 0.1 N HCl for 30 minutes.
4. After above treatment, rinse the electrode in distilled water and soak in pH storage solution for 30 minutes.
5. Always recalibrate after cleaning the probe.

Do not attempt to sand or polish the sensing element with sand paper or any other polishing material. Do not use strong solvents such as acetone or carbon tetrachloride

5.2 ORP Probe Maintenance

The ORP probe should always be kept wet. Allowing the probe to dry will permanently damage the probe. The probe should be replaced approximately once per year.

Contamination of the sensing element often results in slow response and inaccurate readings. Clean the element by one of the following procedures about once per month or more often if slowed response is observed:

1. Inorganic Deposits: Immerse electrode tip in 0.1 N HCl for 10 minutes. Wash the tip with distilled water.
2. Organic Oil and Grease Films: Wash electrode tip in a liquid detergent and water.
3. After above treatment, soak the electrode tip in alcohol for 5 minutes and wipe dry, then, soak in quinhydrone saturated pH 4.0 for 15 minutes. Rinse with distilled water.
4. Always recalibrate after cleaning the probe.

Do not attempt to sand or polish the sensing element with sand paper or any other polishing material.

5.3 Conductivity Probe Maintenance

Do not touch the probe cell surface with any hard object.

1. If the probe cell surface is contaminated, soak the probe in light detergent for 15 minutes and then in mild acid for 15 minutes.
2. Rinse the probe in distilled water
3. Always recalibrate after cleaning the probe.

5.4 Controller Assembly Parts List & Technical Support

For the latest and most accurate information on your controller, please refer to the Data Sheets available in the LMI® Online Library at: http://support.lmipumps.com. Use “Product” drop down to select “DM Series”.

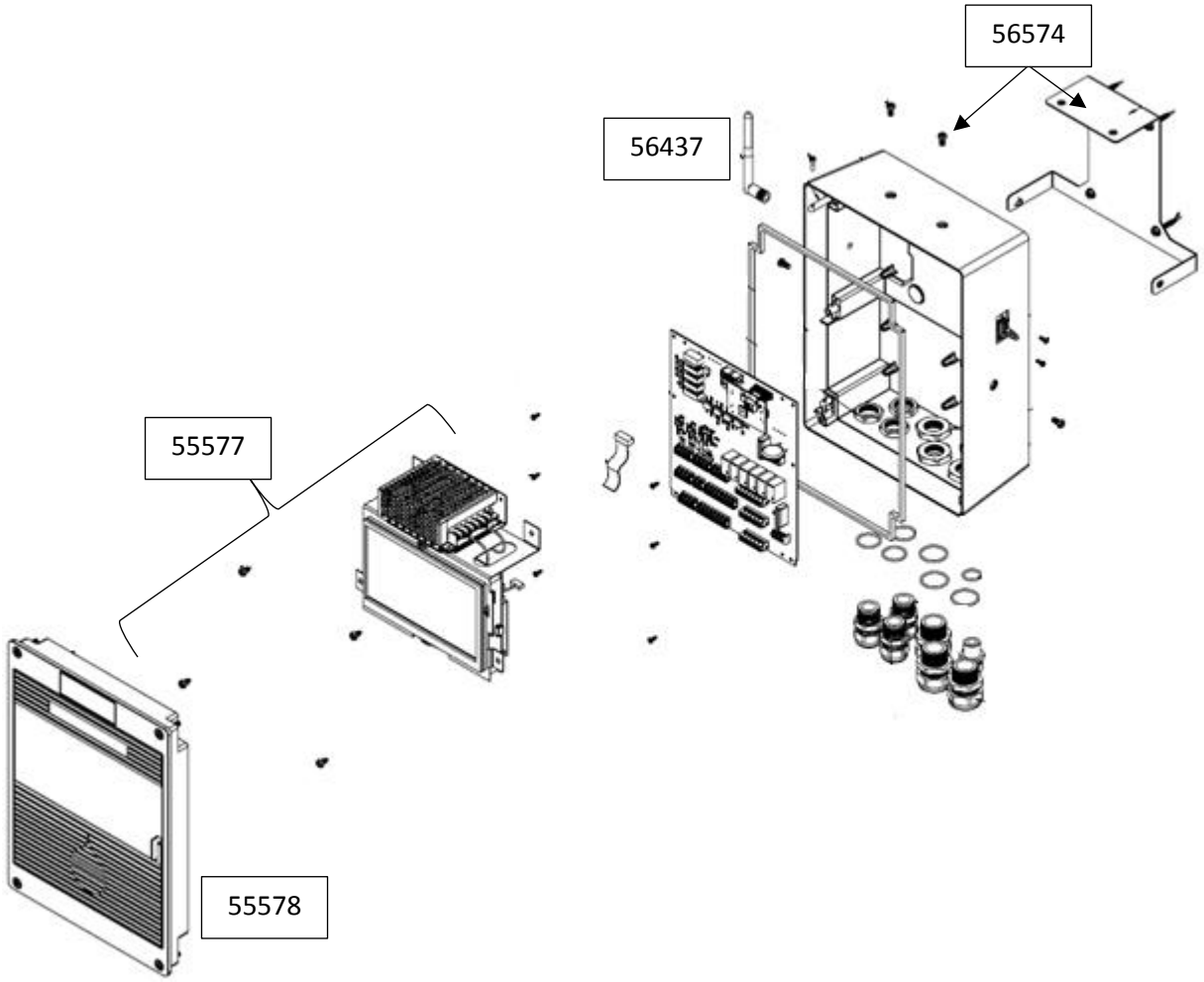


Figure 31: Controller Assembly

Table 7: Accessory and Spare Parts List

LMI PN	Type	Description	Notes
56566	Accessory	3 Slot Flow Cell, Sample Valve	Includes sample valve, 3/4” NPT Inlet/Outlet, Plugs for 2 sensor ports
56567	Accessory	Probe, Cond, Temp, 20 ft Cable - Pt Conductivity, Temperature	1.0 cell constant conductivity probe with temperature sensor and 20 foot cable
56568	Accessory	Flow Switch ASY, 1.5m Cable - F/SW, PVC Tee, Adapt 3/4" NPT	Paddle Flow Switch with 3/4” FSLIP Tee and 1.5 meter cable
56572	Accessory	Cable, 20 ft pH/ORP - BNC to Tinned Leads	20 foot coaxial cable for use with pH or ORP probe.
56569	Accessory	Probe, pH w/out Cable	pH probe, no temperature compensation or cable
56570	Accessory	Probe, ORP w/out Cable	ORP probe, no cable

56573	Accessory	Probe, Temp, 20 ft Cable - Incl 3/4" Fitting	Temperature sensor for use with pH probe if conductivity probe is not used. Includes fitting for 3/4” NPT and 20 foot cable
34761	Accessory	Boiler Probe Assembly with 1" Cross & 1/2" Conduit	1.5 cell constant boiler probe with cross assembly
34759	Accessory	Boiler Probe	1.5 cell constant boiler probe
34760	Accessory	Cross, 1"	Boiler probe parts
34796	Accessory	Conduit Box Assembly	Boiler probe parts
35058	Accessory	Nipple, 1/2" Conduit	Boiler probe parts
35059	Accessory	Fitting, 1/2" Conduit	Boiler probe parts
35208	Accessory	Orifice Union w/Plates (pre-drilled)	Boiler parts
56954	Accessory	Tee. 1” NPT w/ 3 3/4” Reducers	Tee will fit 56567, 56569, 56570, and 56573 probes with 3/4” NPT inlet/outlet
56955	Accessory	Cable. 20 ft pH/ORP. BNC-BNC	BNC cable for use between a pH or ORP probe and a pre-amp.
55577	Spare Part	Replacement Display Module	Includes LCD Display, Display PCBA, Power Supply, Display Bracket, 4 screws
55578	Spare Part	Lid & Clear Cover	Includes Lid, cushion gasket, 4 captive screws, 4 springs, clear cover, and LMI, Liquitron, Product, and QR Labels
56574	Spare Part	Replacement, Wall Mount ASY	Includes metal wall mount bracket, 4 wall mount screws, and 4 Locking screws
56437	Spare Part	Cellular Antenna, Omnidirectional	Replacement Cellular Antenna with SMA connection
56900	Spare Part	110-120V US Power Cord	6 Foot power cord with plug
56901	Spare Part	220-240V DIN Power Cord	6 Foot power cord with plug
56902	Spare Part	220-240V UK Power Cord	6 Foot power cord with plug
56903	Spare Part	220-240V AUS/NZ Power Cord	6 Foot power cord with plug
56907	Spare Part	220-240V US Power Cord	6 Foot power cord with plug
35711	Spare Part	110 - 120V US Plug Pig Tails	1 Foot power cord with female receptacle

6.0 Troubleshooting

PROBLEM	POSSIBLE CAUSE	SOLUTION
Sensor Slow to Respond or Inaccurate	Sensor Dirty	Clean per **5.0 Spare Parts Replacement and Routine Maintenance**
	Sensor Response Changed	Calibrate Sensor per **4.7 Probe Calibration**
	Sensor Damaged or Expired	Replace sensor with part from **Table 7: Accessory and Spare Parts List**
	Sensor Cable Too Long	pH and ORP sensors must be within 20 feet without the use of a preamp. Try using a shorter cable or add a preamp. The battery powered Sensorex PHAMP-1 may be used with an LMI 56955 BNC-BNC 20-foot extender cable.
	Sensor Wired Incorrectly	Disconnect power and open the controller lid.
		Ensure wires were not pulled from screw terminals.
		Ensure pH/ORP clear wire is in positive terminal and black wire is in negative terminal.
	Sensor Input Electronics Damaged	Use jumpers to test controller and replace controller if sensor input is damaged. Return jumpers to normal position when testing is complete.
		Conductivity – Move jumper on SW1 and SW3 from pins 1&2 to pins 2&3. Verify measurement of 3300 µS.
		Temperature – Move jumper on SW2 from pins 1&2 to pins 2&3. Verify measurement of 77 F.
		pH – Move jumper on SW4 from pins 1&2 to pins 2&3. Verify measurement of 3.14 pH.
		ORP – Move jumper on SW5 from pins 1&2 to pins 2&3. Verify measurement of 242 mV.
Unable to Unlock System	PIN Code Lost Or Forgotten	Use the Master PIN to reset the PIN. Enter “1364” when prompted for the PIN and then create a new PIN.
Touch Events Not Recognized	Touchscreen calibration incorrect, causing touch events to be shifted (i.e. require tapping just below each button)	Calibrate touchscreen by accessing Settings – System Settings – Calibrate Touchscreen.
	Dirty Hand, Gloved Hand, Or Use of Fingernail	The capacitive touchscreen requires a clean fingertip for touch detection.
	Water on Display	Wipe the display with a clean cloth.

Firmware Update Failure	Files Not Detected	Insert USB Drive with files in folder called “Upgrade”
		Display board update file must be named “rbins.tgz”, main board update file must end in “.bin”
		Tap the LMI Connect / USB Toggle Switch to ensure USB is selected
Profile Clone Failure	File Not Detected	The filename must be formatted as three sections separated by underscores as follows: “<description>_Profile_<time>.csv”. The <description> and <time> fields can be anything. For example, “East CT_Profile_07202018_0254PM.csv”
Water Inside Unit	Cable Gland Loose	Tighten cable glands
	Dowel Missing	Replace missing dowels with short lengths of cable
	Cable Undersized	Use the smallest possible hole to accommodate the cable
Chemical Pump Will Not Run	Flow Switch Wired Incorrectly	Disconnect power and open the controller lid. Ensure wires were not pulled from screw terminals. If no flow switch is used, ensure the jumper is in place in J13.
	Flow Switch Malfunction	Disconnect power and open the controller lid. Ensure wires were not pulled from screw terminals. Use multimeter to check for short during flow.
		Check piping for closed valves or blockages.
	Power Relay Fuse Blown	The power relays share a common 6.3A Slow Blow Fuse. Purchase a 5x20mm 6.3A 250VAC fuse such as Bel Fuse 5ST 6.3-R. Disconnect power and open the controller lid.
Process Out of Range	Wrong Chemical Is Used	Access Manual Mode and ensure the correct pump is activated when each toggle switch is pressed.
		Verify chemical in tank
	Chemical Tank Is Empty	Refill chemical tank
	Pump Lost Prime	Open priming port and use Manual Mode to activate pump. Refer to pump Instruction Manual for additional troubleshooting.
	Pump Diaphragm Rupture	Refer to pump Instruction Manual for Diaphragm Replacement procedure.
	Sensor Inaccurate	Refer to sensor troubleshooting

Low Battery Alarm	The real-time clock battery backup is running low. The battery is used to maintain time when power is disconnected.	Purchase a CR2450 coin cell battery. Disconnect power and open the controller lid. Remove the battery from the battery holder and replace battery with the positive side down (away from the display). Power on the controller and set the date and time in System Settings – Date/Time.
System Failure	High Temperature Environment	Ensure the controller is in an environment that is less than 50 C. Avoid direct sunlight if possible.
	Screen Locked	Cycle power to the unit to reset
LMI Connect Connection Issue	Unit Not Activated	Refer to **Section 4.5.10** for activation instructions
	Antenna Disconnected	Ensure the antenna is firmly attached to the outside SMA connector and pointing upwards.
	Low Signal Environment	Purchase cellular amplifier or use an extender cable with an SMA Male connector to mount an external antenna
	Antenna Cable Disconnected	Disconnect power and open the controller lid. Check antenna cable to see if it is hanging loose from external connector. If it is, contact your local distributor for assistance.

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Manufacturing Location:
Mack Technologies
27 Carlisle Road
Wesftord, MA 01886