



UV-C LED Water Disinfection System

Operation and Maintenance Manual



PearlAqua

Models: D, E & G

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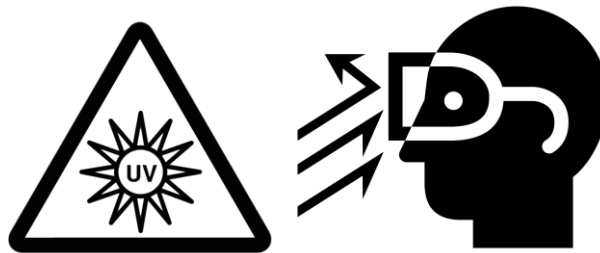
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Table of Contents

1. Safety	3
a. Safety Interlock Switch	3
2. General Information	4
a. UV-C Water Disinfection	4
b. UV-C LEDs	5
c. Product Description	5
d. Electrical Specifications	7
3. Installation	8
a. Electrical Connection	9
b. Electrical Connection Application Examples	10
4. Operation	12
a. Status Indicators	12
b. Current Loop Output	14
5. Maintenance	16
a. UVinaire® Replacement	16
b. Cleaning	17
6. Trouble Shooting	19
7. Warranty	21
a. General Statement of Warranty	21
b. Lamp Warranty	22
c. Limitations of Warranty	22

1. Safety

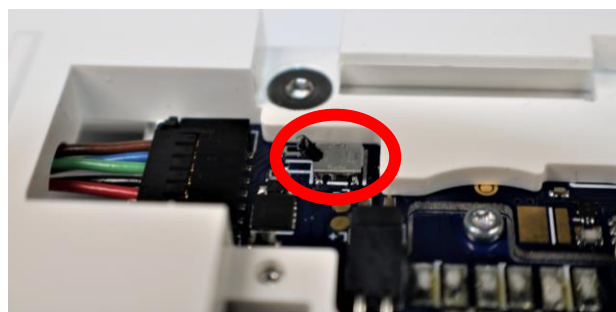
This device produces harmful ultraviolet radiation. Direct contact could damage the eyes and skin. Do not look directly into inlet or outlet ports without the use of ultraviolet resistant safety glasses.



- Always comply with local plumbing and electrical codes.
- Always disconnect power from the unit before performing any type of maintenance or servicing.
- Never submerge the unit in water.
- Do not use the unit if there is any sign of damage.
- Do not install the unit in an area subject to full sunlight.
- Keep children away from device.
- Inlet water temperature should not exceed 65°C (149°F).
- Ambient temperature surrounding the unit should not exceed 40°C (104°F).
- Do not exceed 100 psi (6.9 bar) (72.5 psi [5 bar] for 24G) static water pressure at unit.
- The unit should only be operated according to the guidelines described herein.

a. Safety Interlock Switch

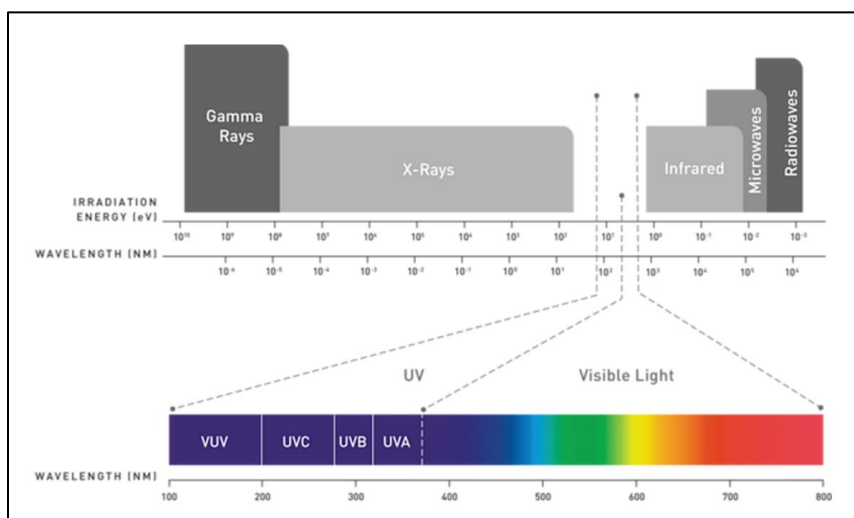
All UVinaires are equipped with a safety interlock switch. When the UVinaire is not properly installed in the PearlAqua, or uninstalled, the safety interlock switch deactivates the UV-C LEDs. The PearlAqua should NOT be operated if this switch has been damaged or tampered with.



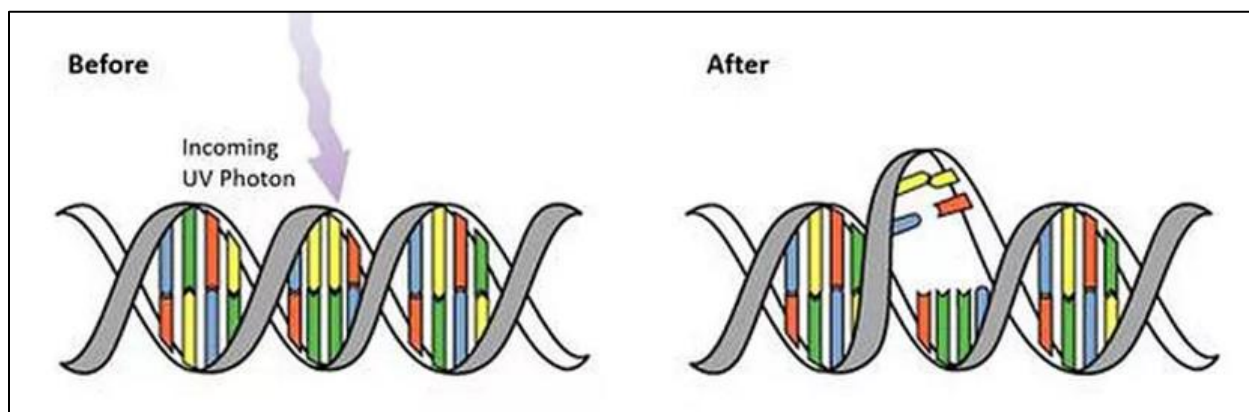
2. General Information

a. UV-C Water Disinfection

Ultraviolet (UV) water disinfection technology has become an increasingly popular tool in water treatment over the past two decades, due in part to its ability to provide treatment without the use of harmful chemicals. UV represents wavelengths that fall between visible light and x-ray on the electromagnetic spectrum.

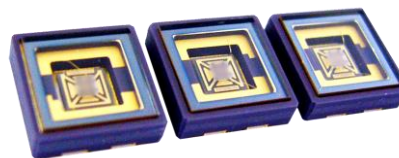


The UV range can be further divided into UV-A, UV-B, UV-C, and Vacuum-UV. The UV-C portion represents wavelengths from 200 nm - 280 nm, which is the wavelength range used in our LED disinfection products. UV-C photons penetrate cells and damage the nucleic acid, rendering them incapable of reproduction, or microbiologically inactive.



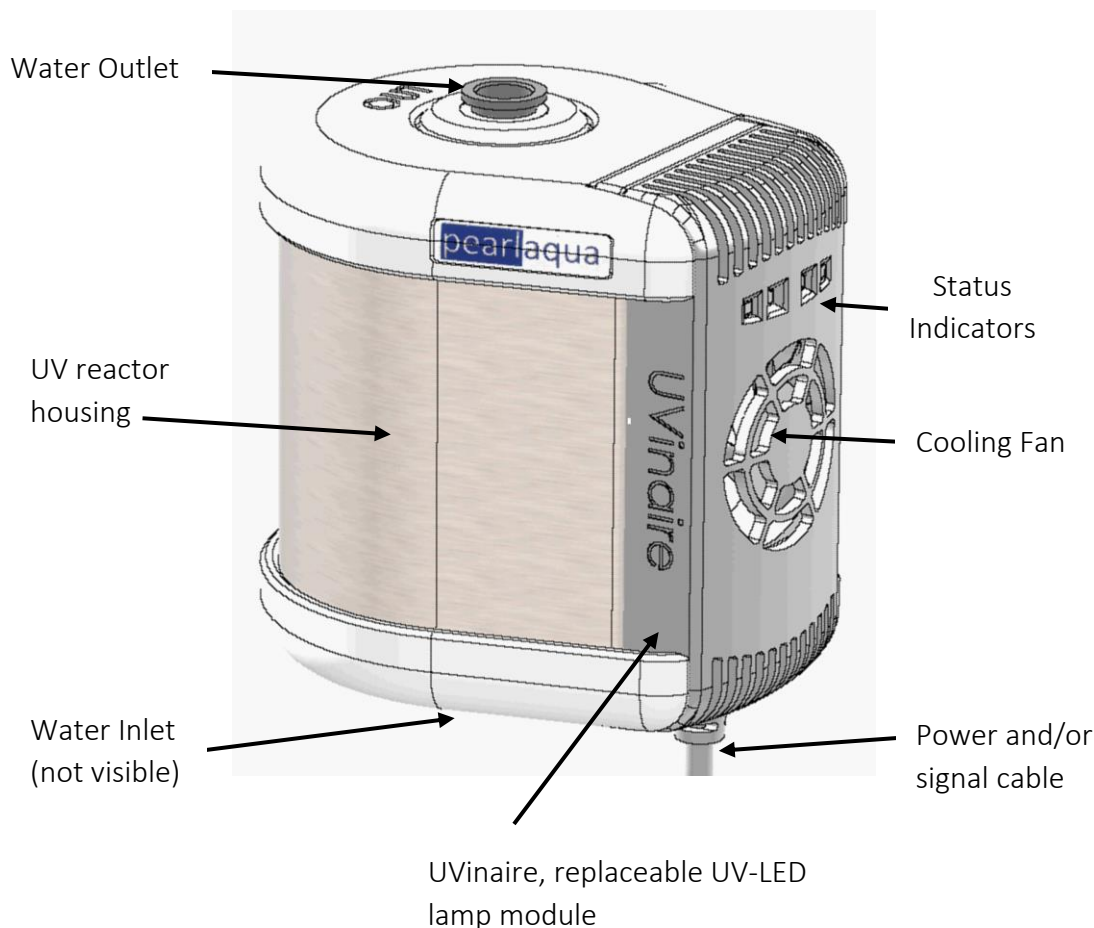
b. UV-C LEDs

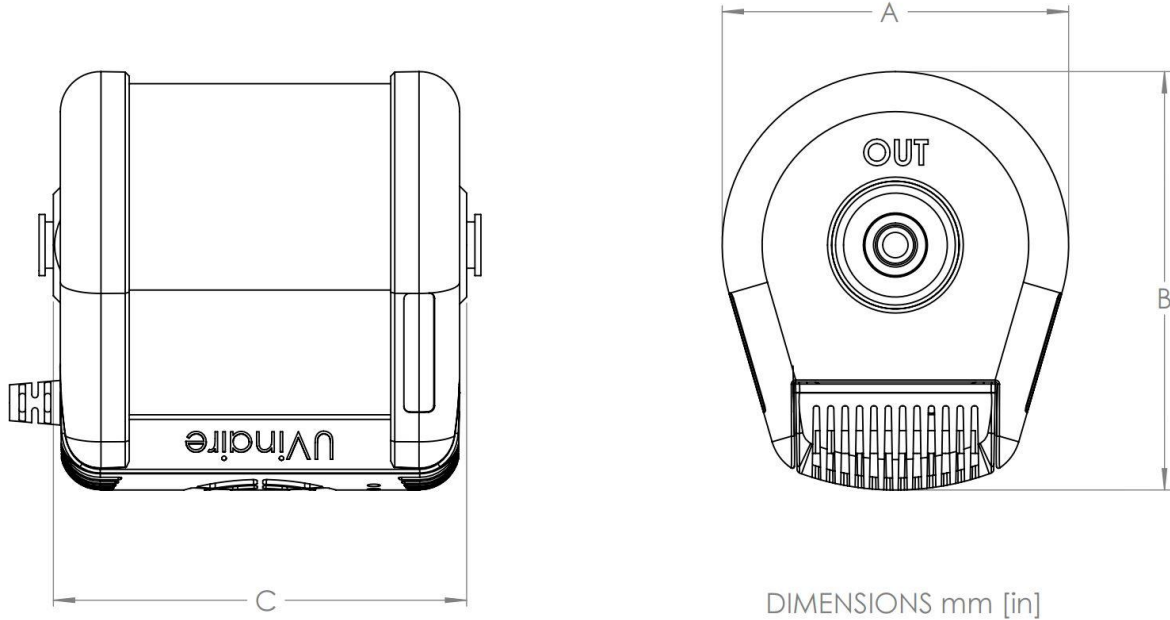
A light-emitting diode (LED) is a semiconductor light source. It is a p–n junction diode, which emits light (or photons) when activated. The PearlAqua utilizes small, state-of-the-art, UV-C LEDs, which emit photons in the UV range, to provide pathogen reduction without the use of harmful chemicals or heavy metals. Use of LEDs allows the PearlAqua to achieve full intensity power upon start-up, withstand unlimited power cycles without impacting device life, and eliminate expensive disposal processes.



c. Product Description

PearlAqua is the world's first mercury-free, UV-C LED product designed for water disinfection. Applications include medical devices, life sciences, remote communities, defense, emergency response, transportation, and commercial water.





	9D	15E	24G
A	73 [2.87]	87 [3.42]	127 [5.00]
B	92 [3.62]	105 [4.13]	148 [5.83]
C	100 [3.93]	100 [3.93]	140 [5.51]

Each model has specific design and operating specifications, outlined in the following tables.

Model Number	9D	15E	24G
UV-Transmittance	> 90% recommended		
Max Flow [lpm (gpm)]	3 (0.8)	8.5 (2.2)	14 (3.7)
Headloss at Max Flow [psi (bar)]	1.16 (0.08)	0.73 (0.05)	0.29 (0.02)
Inlet/Outlet Connection	1/4" Push to Fit	3/8" Push to Fit	1/2" FNPT
Max Pressure [psi (bar)]	100 (6.9)		72.5 (5)
Water Temperature [°C (°F)]	0-75 (32-167)		
Environmental Protection	IP52		
Lamp Life (hours)	Up to 10,000		
Max Ambient Temperature [°C (°F)]	40 (104)		
Input Voltage [V DC]	12		
Input Power [W]	8.6	13.6	21.0
Weight [kg (lbs)]	0.74 (1.6)	0.92 (2.0)	2.44 (5.4)

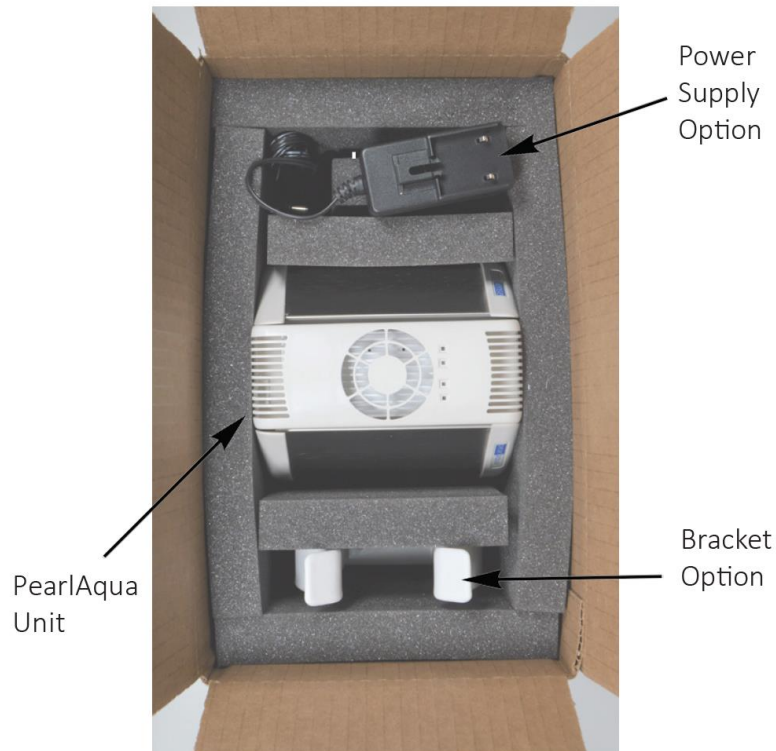
d. Electrical Specifications

Power Input		9D-OEM	15E-OEM	24G-OEM	Units
Input Voltage	Recommended	12			V
	Absolute Max	20			V
Supply Current Max		1.25	1.8	2.5	A
Nominal Power Consumption		10	16	26	W
Recommended Power Supply Capacity		18	18	36	W
Remote IO Input					
Input Voltage	UV Enabled (Min)	5			V
	UV Disabled (Max)	2			V
	Absolute Max	15			V
Response Latency (Max)		0.25			Sec
Input Resistance		9.4			K-Ω
4-20 mA Current Output					
Input Voltage*	Recommended	12			V
	Absolute Max	24			V
Output Accuracy Tolerance		+/- 1			%

*Refer to Current Loop Output section 4.c for further information

3. Installation

Remove the PearlAqua from its packaging. Ensure contents of package are complete.



When determining the installation location of the device, consider ease of access, maximum length of plumbing, minimum bend radii of plumbing, electrical connections, and air circulation. Ideally, the unit should be mounted with the inlet and outlet oriented vertically to allow for easy draining.

1. Do a quick test fit of the unit before beginning any mounting panel modifications. Remember to measure twice, cut once.
2. Once comfortable with the installation location, proceed to install the mounting bracket or user supplied retaining components.
 - a. For a D unit, the single bracket should be located in the middle of the unit. For an E or G unit, mount the brackets approximately 1.5 to 2 inches from either end of the unit. Note the D and E bracket is smaller than the G bracket.

3. Connect water lines to the inlet and outlet of the PearlAqua. Polyethylene or nylon tubing should be used. Use tubing appropriately sized for the fittings selected.
4. Fill and pressurize the system to check for leaks in the plumbing. Correct any leaks found by verifying you have the appropriate tubing and reinstalling the plumbing (Plumbing can easily be removed by pressing on the outside of the fitting while pulling the tube out). If there is a leak found within the internal seals of the PearlAqua, return the unit for a warranty replacement.
5. Once the system is leak free, proceed to connecting the unit to the power supply, per the following section.

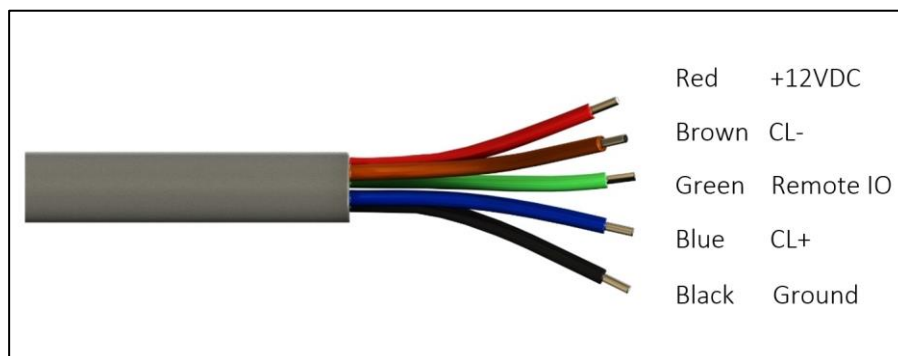


a. Electrical Connection

The PearlAqua unit comes equipped with a 6-conductor power cable. On units with the Power-supply option, this cable is terminated in a 2.1x5.5 mm barrel plug.

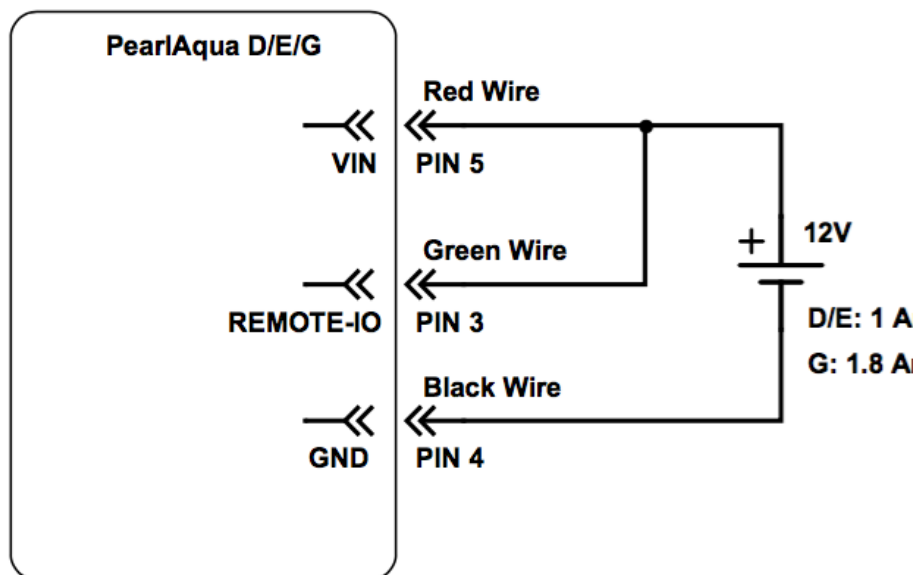


If it is not terminated with a barrel plug, the cable can also be used to gain access to peripheral control and monitoring functions of the PearlAqua.

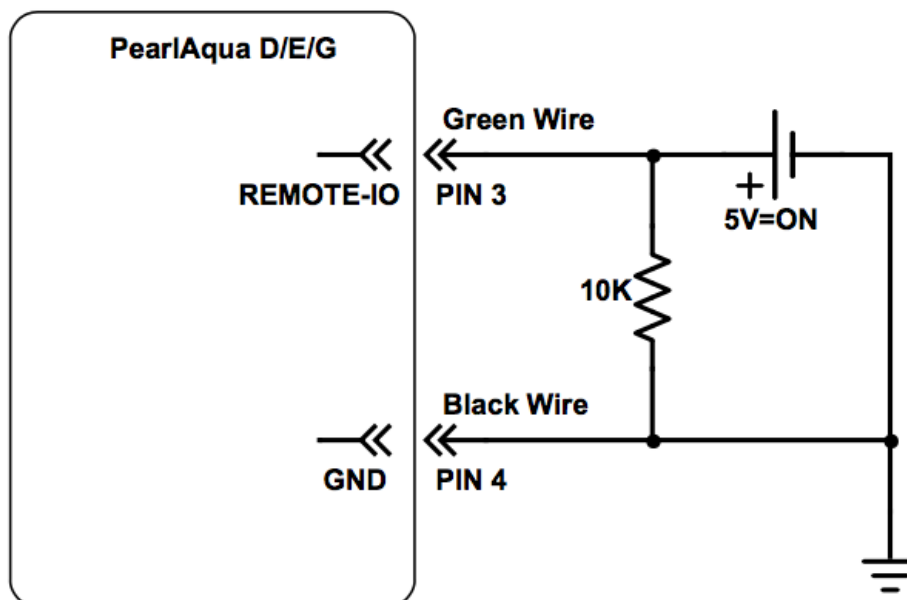


b. Electrical Connection Application Examples

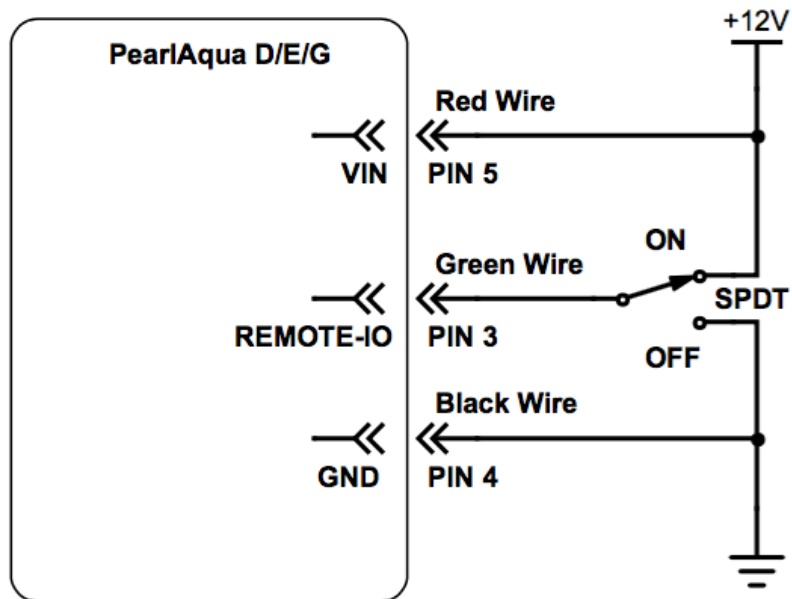
Supplying PearlAqua from External Power Source



Logic-Level Control of Remote On/Off Functionality



Remote On/Off Control with External Flow-switch



4. Operation

a. Status Indicators



The PearlAqua is equipped with four LED Indicators that allow the device status to be quickly determined.

Indicator Numbering



Number	Color	Indicator
1	Blue	UV Indicator
2	Red	Error Indicator
3	Yellow	High Temp Warning
4	Green	Lamp Life Warning

UV Indicator (Indicator 1, Blue)

This indicator communicates the status of the UV-C LEDs. This indicator can either be off or solid, it does not blink.

Indicator Status	Meaning
Off	UV LEDs are off
Solid	UV LEDs are on

Error Indicator (Indicator 2, Red)

This indicator communicates system errors. Information communicated by this indicator can take the form of off, solid, or blinking.

Indicator Status	Meaning
Off	Unit is operating normally
Solid	UV-LED Failure*
Blinking	UV intensity is below set point

*Reinstall or change the UVinaire

Lamp Health Indicators

These indicators are comprised of a Green and Yellow signal. Information communicated by these indicators can take the form of off, solid, or blinking.

Temperature (Indicator 3, Yellow)

Indicator Status	Meaning
Off	Unit is operating normally
Solid	Pervious overheating has occurred*
Blinking	Unit is overheating

*Reset the yellow indicator by restarting the PearlAqua

Lamp Life (Indicator 4, Green)

Indicator Status	Meaning
Dark (Off)	Lamp life has expired*
Solid	Unit is operating normally
Blinking	Approaching lifetime limit**

*Lamp must be replaced to continue optimal disinfection performance

**User should acquire a replacement UVinaire

For additional information, refer to Section 6. Troubleshooting.

b. Current Loop Output

The PearlAqua is configured with a 4-20mA current loop output module used to communicate system status information.

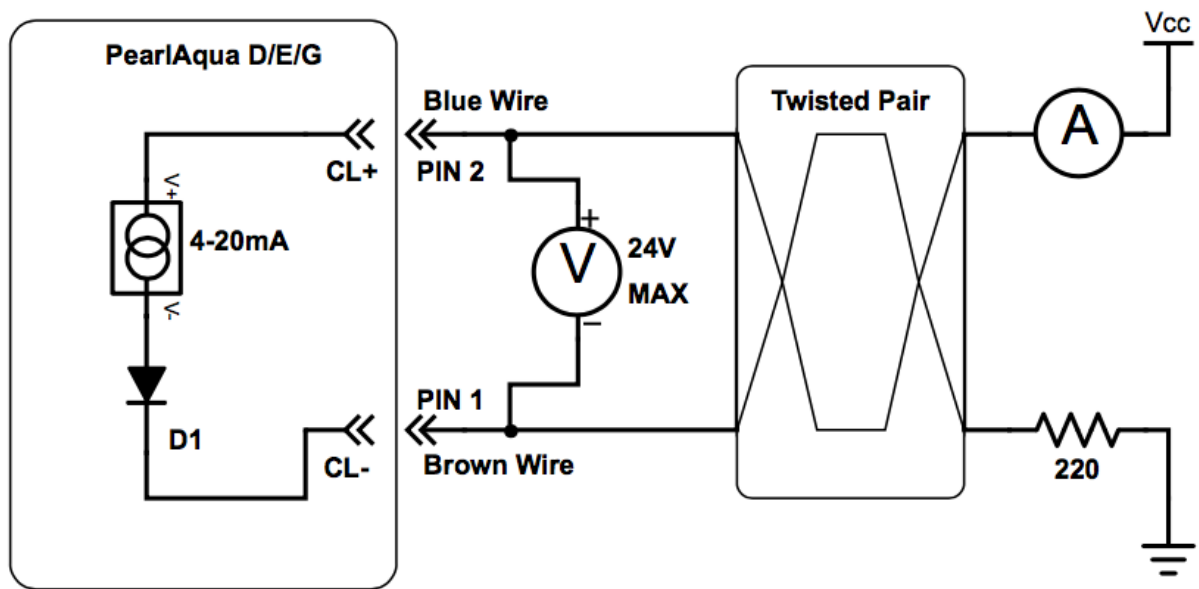
The Current Loop Output communicates information on three topics: lifetime, UV intensity, and error. The Current Loop will transmit a topic signal - either 4mA, 5mA, or 6mA - which correspond to lifetime, UV intensity, or error, respectfully. After each topic signal, the Remote IO will send a condition signal between 10mA and 20mA. The condition signal interpretations are summarized in the table below.

The Current Loop will cycle through the 6 signals (one topic signal and one condition signal for each lifetime, UV intensity, and error) automatically. Each signal will be displayed for 3 seconds.

Output values

Topic	Topic Signal	Condition Signal
Lifetime	4mA	10mA – The UV LEDs have been on for 0 hours 11mA – The UV LEDs have been on for 1,000 hours ... 15mA – The UV LEDs have been on for 5,000 hours ... 19mA – The UV LEDs have been on for 9,000 hours 20mA – The UV LEDs have been on for 10,000 hours (end of lamp life)
UV Intensity	5mA	10mA – UV intensity at 0% 11mA – UV intensity at 10% ... 15mA – UV intensity at 50% ... 19mA – UV intensity at 90% 20mA – UV intensity at 100%
Errors	6mA	10mA – No Error 12mA – UV-C LED Failure 14mA – Unit is overheating 16mA – Overheat and LED failure.

Reading 4-20mA Loop Output from PearlAqua



5. Maintenance

a. UVinaire Replacement

1. Check the Lamp Lifetime Indicator or the Current Loop Output to be sure the UVinaire needs to be replaced.
 - a. The indicator (green) should be dark (off).
 - i. See Section 4.a Status Indicators for more information.
 - b. The Current Loop Output should indicate the lamp has been on for 10,000 hours. See Section 4.e for more information on the Current Loop Output.
2. Disconnect power to the PearlAqua.
3. Apply pressure to the top of the UVinaire until it clicks out of place. Slide the UVinaire down the front of the PearlAqua. Dispose of the consumed UVinaire by returning it to Aquisense for no-cost recycling.



4. Check the quartz window for fouling. Do not apply pressure or push on the quartz window. Wipe away any fouling on the outside of the window using a soft cloth. Finish with isopropyl alcohol and let dry.



5. Remove all packaging from the new UVinaire.
6. Hold the UVinaire in your hand so the Indicator LEDs are toward the top of the UVinaire. Carefully line up the new UVinaire with the grooves in the PearlAqua and slowly slide the UVinaire up the front of the PearlAqua until it clicks into place.



7. Perform a power test by plugging the unit in without water flowing through it. If the Indicators communicate all is well (For a new UVinaire, the Blue and Green Indicators should be on while the Red and Yellow indicators are off. See section 4.a for more information on the indicators.), proceed to the next step. If the Indicators communicate an error (See section 4.a.), try reinstalling the UVinaire and cleaning the connections between the PearlAqua and the UVinaire. If the Indicators do not communicate all is well in a few attempts, see Section 6 Troubleshooting. If the error persists, call Aquisense.
8. Reinstall the PearlAqua. If the Indicators do not turn on, check the electrical connection. If the Indicators do not come on in a few attempts, call Aquisense.

b. Cleaning

Fouling may occur in the PearlAqua depending on the age of the unit and the quality of the water flowing through it.

1. Disconnect power to the PearlAqua and remove plumbing.
2. Apply pressure to the top of the UVinaire until it clicks out of place. Slide the UVinaire down the front of the PearlAqua.



3. Check the quartz window for fouling. Wipe away any fouling on the outside of the window using a soft cloth. Finish with isopropyl alcohol and let dry.



4. Seal the inlet (bottom cap) with a stopper or by hand and pour 4 to 8 ounces (118 ml to 236 ml) of isopropyl alcohol into the outlet (top cap).
5. Seal the outlet and gently shake the unit so the alcohol rinses the entire reactor. After a minute of shaking, let the isopropyl alcohol drain out the inlet (bottom cap).
6. Repeat steps 4 and 5 with water instead of isopropyl alcohol.
7. Repeat steps 4 and 5 with water. Let drip dry for 10 minutes before proceeding to step 8.
8. Hold the UVinaire in your hand so the Indicator LEDs are toward the top of the UVinaire. Carefully line up the new UVinaire with the grooves in the PearlAqua and slowly slide the UVinaire up the front of the PearlAqua until it clicks into place.



9. Perform a Power Test by plugging the unit in without water flowing through it. If the Indicators communicate all is well (For a new UVinaire, the Blue and Green Indicators should be on while the Red and Yellow indicators are off. See section 4.a for more information on the indicators.), proceed to the next step. If the Indicators communicate an error (See section 4.a.), try reinstalling the UVinaire and cleaning the connections between the PearlAqua and the UVinaire. If the Indicators do not communicate all is well in a few attempts, see Section 6 Troubleshooting. If the error persists, call Aquisense.
10. Reinstall the PearlAqua. If the Indicators do not turn on, check the electrical connection. If the Indicators do not come on in a few attempts, call Aquisense.

6. Trouble Shooting

WARNING: Immediately following an over-heat event, the UVinaire may exceed 65°C (149°F). Avoid skin contact with heatsink.

a. The Temperature Indicator is Blinking AND

i. UV-LED Intensity Indicator is Blinking

Issue: UV-LED intensity is being decreased to prevent overheating. UV-LED intensity will return to normal once safe temperature is reached.

Solution: Verify that ambient temperature is within the specification defined in Section 2.c Product Description. If cooling fan is used, verify that it is functioning. If no fan is present, implement some method of air-circulation over heatsink.

ii. UV-LED Status Indicator is OFF

Issue: UV-LEDs have surpassed critical temperature value and UV-LEDs are disabled until temperature returns to normal

Solution: Verify that ambient temperature is within the specification defined in Section 2.c Product Description. If cooling fan is used, verify that it is functioning. If no fan is present, implement some method of air-circulation over heatsink.

b. The UV-LED Indicator is OFF AND

i. Temperature Indicator is NOT Blinking

Issue: Remote On/Off signal is below threshold (See Section 4.b)

OR

UV Interlock switch is not engaged entirely. See Section 1.a Safety Interlock Switch for more information.

Solution: Verify Remote IO signal is within "UV-On" thresholds (Section 4.b). Verify that UVinaire is correctly installed.

c. The Lamp Life Indicator is Blinking or OFF AND

i. Temperature Indicator is NOT Blinking

Issue: The UV-C LEDs are nearing the end of or have exceeded the operational lifetime.

Solution: Acquire replacement UVinaire from Aquisense

- ii. UV-Status Indicator Blinks on Briefly then ALL indicators turn OFF. Unit restarts and the UV-Status Indicator Blinks on Briefly then ALL indicators turn OFF again.

Issue: Power supply is insufficient

Solution: Use Power Supply with ratings according to Section 4.b

d. Water leaks from either the top or bottom tubing connections

Issue: Inlet/Outlet tubing is faulty

Solution: Remove Inlet/Outlet tubing and carefully re-cut ends. Verify ends are smooth. Verify that tubing is either polyethylene or nylon as specified in Section 3 Installation.

e. Current-Loop “Topic Signal” Values are not as stated

Issue: Current loop is not regulating correctly

Solution: Verify enough voltage is available to Current-Loop driver. Refer to Application Examples, Section 4.d, for more information.

7. Warranty

a. General Statement of Warranty

The warranty period is 24 months from date of delivery, covering all failures due to material and product assembly, excluding consumables - see Section 2.B: Lamp Warranty.

This warranty shall not apply to any failure or defect which results from the Equipment not being operated and maintained in strict accordance with instructions specified in the AquiSense Operation and Maintenance manual or defect which results from mishandling, misuse, neglect, improper storage, improper operation of the Equipment with other equipment furnished by the Owner or by other third parties or from defects in designs or specifications furnished by, or on behalf of, the Owner by a person other than AquiSense. In addition, this warranty shall not apply to Equipment that has been altered or repaired by anyone except AquiSense, their Authorized representative, or personnel acting under specific instructions from AquiSense.

The Owner must notify AquiSense in writing at info@aquisense.com within 5 days of the date of any Equipment failure. This notification shall include a description of the problem, details of the product name (e.g. PearlAqua), model number (e.g. 15E) and serial number - all found on the product label.

The Owner will fully cooperate with AquiSense in attempting to diagnose and resolve the problem by way of telephone/web support. If the problem can be diagnosed by telephone/web support and a replacement part is required, AquiSense will either, at AquiSense expense, ship a repaired, reworked or new part to the Owner. If the problem is not attributable to a breach of this warranty, AquiSense reserves the right to invoice the Owner for this service.

This warranty is lien of all other warranties whether written, oral, implied or statutory. Without limitation, no warranty of merchantability or fitness for a particular purpose shall apply to the Equipment.

b. Lamp Warranty

Operating Hours. Unlike mercury vapour UV-C lamps, the lifetime of UV-C LEDs is not effected by on/off cycles. However, like all light sources, LEDs are subject to aging over time. AquiSense Technologies have engineered an integrated UV-C LED lamp module (UVinaire™) that contains: power regulation, temperature management, and intensity monitoring (optional). In addition, operating temperature and lamp on-time data is automatically stored. When operated in accordance with AquiSense instructions, it is expected that the UVinaire lifetime (UV-C power over 70% of initial output) will be at least 10,000 hours.

Pre-mature UVinaire Failure. In the case of failure, the following refund/replacement applies:

Up-to 500 operating hours	:	full replacement
Over 500	:	proportionate (pro-rata) credit

In all cases, the operating hours will be determined by on-board UVinaire data storage

c. Limitations of Warranty

This warranty:

- Relates only to faults in material and assembly. It does not cover any form of breakage from mis-handling or mis-operation
- Applies where operating conditions, including the use of a cooling fan for warm temperature operation, are kept in accordance with AquiSense instructions
- Is limited to 24 months after the date of delivery
- Excludes transport costs for the return of parts
- Is restricted to replacement of the UVinaire. AquiSense will not be responsible for any other damages, consequential or otherwise

Return of UVinaire. In all warranty cases, contact info@aquisense.com with details of the product name (e.g. PearlAqua), model number (e.g. 15E) and serial number - all found on the product label.

Disposal of UVinaire. As part of our commitment to the environment, all used or failed lamps returned to AquiSense facilities will be properly recycled at no charge.