2017

OzonePro Installation, Operation and Maintenance Manual

Prepared by
Coritech Services, Inc.
5/9/2017 Job #16002

Revision 1.0

CONTENTS

1. Terms Used in This Manual

Blackstart: startup procedure taking the OzonePro from no power to full operation
Corona discharge: current flowing from an electrode to create an ionized plasma in a media, such as air
HMI: Human-Machine Interface
O2: Oxygen
O3: Ozone

2. Revision History:

Version	Date	Description	Author
0.1	4-1-17	First rough draft	T Crucet, G Bilek
0.3	4-7-17	Revisions	G Bilek, T Crucet
0.35	4-9-17	New sections added	T Crucet
0.36	5-2-17	Added items to to fig. 1 & 2, corrections to notes of fig. 4	G Bilek, T Crucet
1.0	5-9-17	First Release	G Bilek, T Crucet

3. Important Information

3.1 Copyright and Intellectual Property

Specifications and information are subject to change without notice by Climate Control Systems, Inc.

3.2 Safety Notices

This manual contains important safety, installation and operating instructions for the OzonePro System.

Only qualified personnel can install, operate and maintain the OzonePro System. Qualified personnel should have completely read and understood this manual and safety instructions.

The OzonePro System is connected to multiple sources of energy – both AC and DC electrical sources. Only **qualified personnel** should be allowed to work on any component of the OzonePro System.

Proper procedures, such as Lock Out Tag Out (LOTO), must be established and followed along with the use of proper Personal Protective Equipment (PPE) when working on one or more components of the OzonePro System.

Safety is your responsibility. Follow established safety procedures and processes (e.g. De-energize sources, Check/Test, LOTO). Be aware of the hazards associated with ALL components of the OzonePro System.

Some of the more common hazards associated with the OzonePro System that one should be aware of are:

- **The presence of purified oxygen**: the O2 Generator compresses ambient air and purifies it to ~94% oxygen. Although self-contained, this presents a potential oxidant source. Flammable materials should not be stored near the OzonePro system.

- **The presence of ozone gas**: The quantities used by the OzonePro are self-contained and injected directly into the water stream for decontamination. Within minutes, the ozone dissipates while oxygenating the water. Unfortunately, the same chemical properties that allow ozone to alter organic material in air and water also give it the ability to react with organic material inside the human body. Even low levels of ozone exposure can cause coughing, chest pain, shortness of breath, wheezing and throat irritation. As a precaution, there is an ozone gas detection sensor that will shut down ozone production in the event of a leak.
- **High Voltage** – Various power sources are required to run the OzonePro System and represent 'continuous' sources of High Voltage DC or AC that are always 'ON'. The internal OzonePro System circuitry can remain briefly energized after input sources have been disconnected. Only qualified, trained and authorized personnel should work on the electrical aspects of this system, and all enclosures should remain closed when operating or connected to power sources.

3.3 About This Manual

The instructions contained in this manual are not intended to cover all details or variations in equipment types, nor may it provide contingency concerning the installation, operations, or maintenance of this equipment. Should additional information be required contact your Climate Control sales representative.

The contents of this guide shall not become a part of or modify any prior or existing agreement, commitment, or relationship. The sales contract contains the entire obligation of Climate Control Systems. The warranty contained in the contract between the parties is the sole warranty of Climate Control Systems and any statements contained herein do not create new warranties or modify the existing warranty.

Any electrical or mechanical modifications to this equipment without prior written consent of Climate Control Systems may void all warranties and may void the UL/CSA listing or other safety certifications. Unauthorized modifications may also result in a safety hazard or equipment damage.

Misuse of this equipment could result in injury and equipment damage. In no event will Climate Control Systems be responsible or liable for direct, indirect, special, or consequential damage or injury that may result from the misuse of this equipment.

WARNING: THIS MACHINE PRODUCES OZONE INTERNALLY FOR WATER TREATMENT. EVEN LOW CONCENTRATIONS OF OZONE CAN CAUSE COUGHING, CHEST PAIN, SHORTNESS OF BREATH, WHEEZING AND THROAT IRRITATION. PLEASE OBSERVE CAUTION AND REVIEW THE MATERIAL SAFETY DATA SHEET ON PAGE 49.

4. Scope

This manual covers installation, operation and maintenance of the OzonePro System. Sections include:

- Modes of Operation
- Setup, blackstart and shutdown
- HMI screens, Online screens
- Troubleshooting

5. Overview

5.1 Introduction

The OzonePro System is a highly effective greenhouse closed-loop water treatment system that uses variable injection of ozone to eliminate organic and inorganic contaminants. It is thousands of times faster than chlorination without chemical residues, and the ozone dissipates within minutes to re-oxygenate the water, making it ideal for large-scale agricultural production. The OzonePro is currently deployed in greenhouses all over the world.

5.2 Components

Oxygen Generator

This generator creates the purified oxygen that becomes the basis for ozone production. An air compressor injects air into a vessel containing nitrogen-trapping material; while the inert, trapped nitrogen is vented from the first vessel, oxygen is allowed to flow to the second vessel, which traps more nitrogen; then the airflow is sent back to the first vessel. By performing this process repeatedly, the nitrogen is removed and 94% pure oxygen is the result. This is directed to the Ozone Generator.

Ozone Generator

The principle of ozone generation involves passing oxygen through a pair of electrodes carrying a high-voltage AC current. A corona discharge takes place in the gap, ripping apart the oxygen to form the unstable ozone molecule. The ozone is injected into the water stream, where it quickly oxidizes and eliminates contaminants. After a few minutes, the remaining ozone in the water naturally breaks down into oxygen, which benefits crops at the root zone.

5.3 Modes of Operation

Closed Loop

It is recommended to configure the OzonePro as a closed-loop system. In this configuration, a portion of the water in the reservoir tank is always being cycled through the OzonePro for decontamination. A separate pump system sends the water to the crops area and returns it from the drain basins.

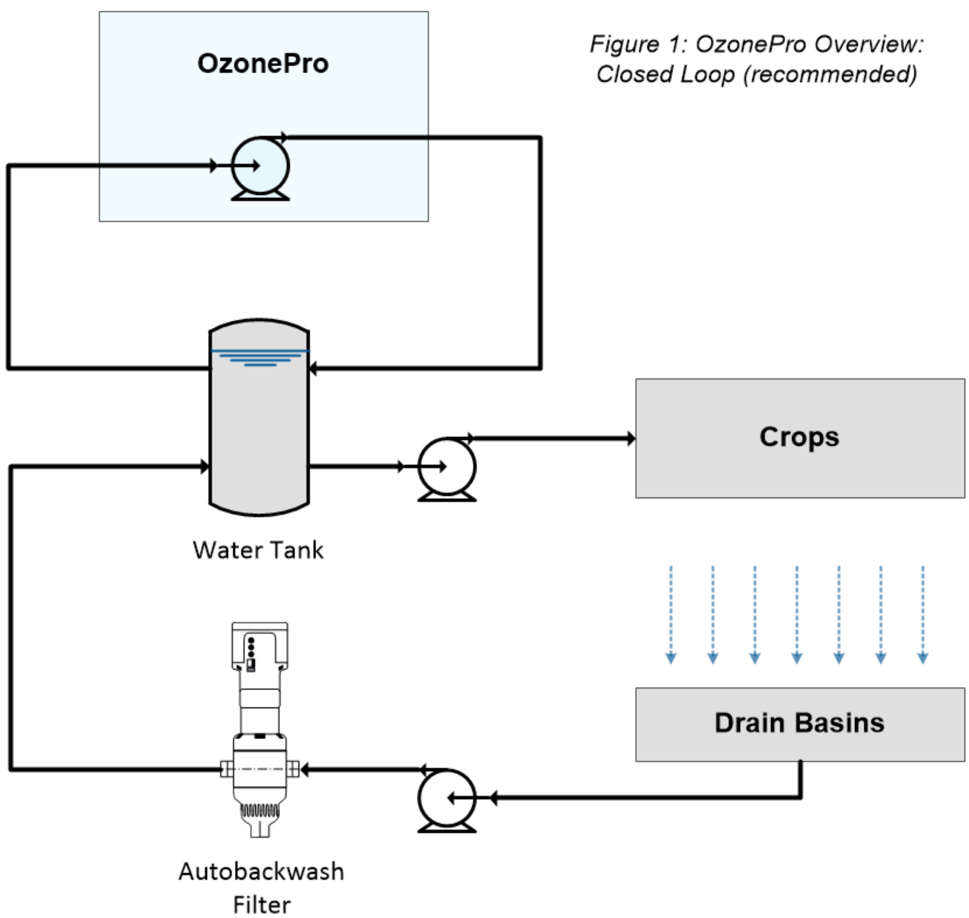
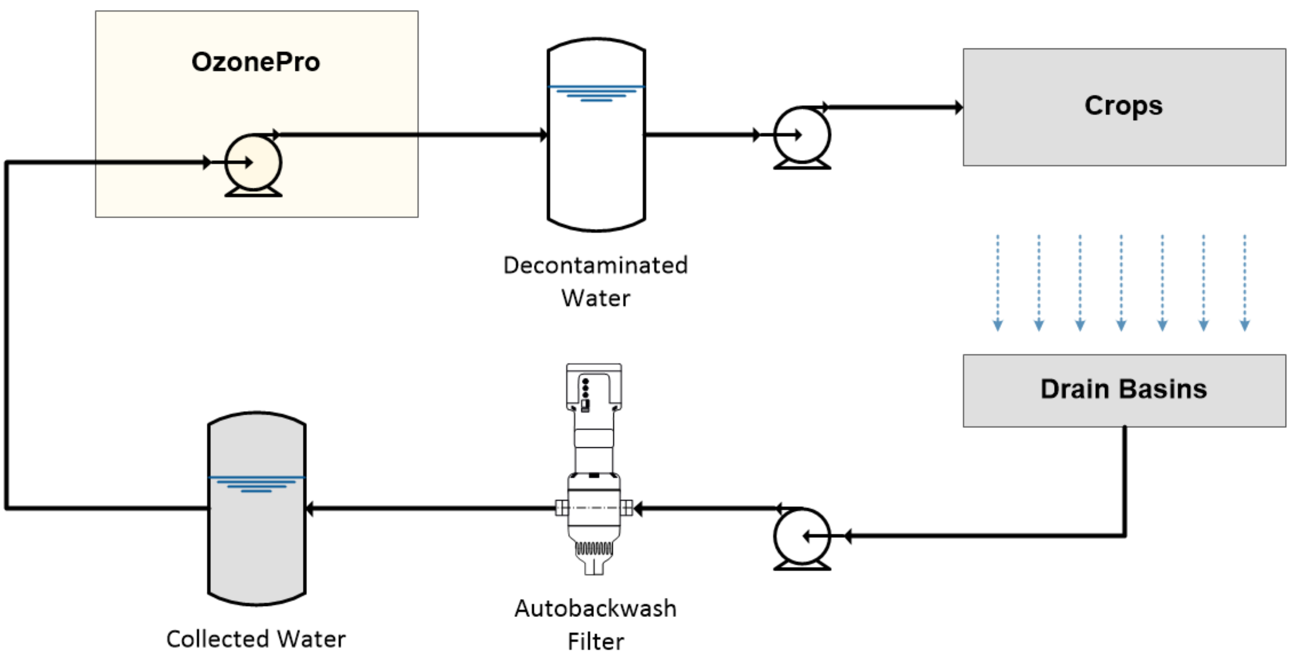


Figure 1: OzonePro Overview: Closed Loop (recommended)

Single Pass

In the single pass mode of operation, two separate reservoir tanks are used, separating the treated supply water from the return water. A single pump is dedicated to return, and the OzonePro skid pump sends treated water to the decontaminated water reservoir.

Figure 2: OzonePro Overview: Single Pass



6. OzonePro System Exterior - Front

Ozone System front, side exterior

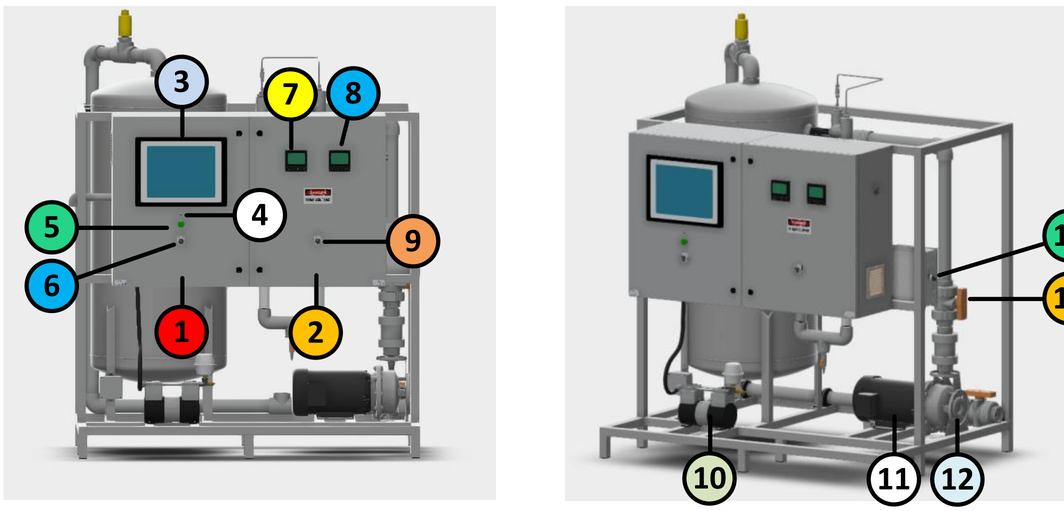


Figure 3: Ozone System front and side exterior

1 **O2 Generator Enclosure**

Location of the oxygen generator and HMI. The oxygen generator takes ambient air from the compressor, purifies it to 94% oxygen, and sends to the O3 Generator. The HMI derives control power from the rack in the O3 Generator Enclosure.

2 **O3 Generator Enclosure**

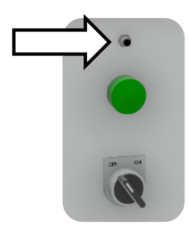
Houses the Ozone (O3) Generator, which takes purified oxygen as input from the O2 Generator. Also houses the controller for the OzonePro System.

3 **HMI**

Control and status display of the OzonePro System. Power for the HMI is derived from the power supply inside the O3 Generator Enclosure.

4 **Computer Power Button**

Press to turn on the computer in the event that the computer has been shut down using the "Start" button in Windows, which is considered a soft shutdown. When power is cycled to the entire machine, the computer will start up automatically.



5 **O2 System Run Status Light**
Illuminates if the O2 Generator is enabled (on/off switch is ON), and the startup delay timer has elapsed.

6 **O2 System Power Interlock Switch**
This switch must also be on for the OzonePro System to operate. If it is left off, a critical Oxygen Pressure alarm will eventually be triggered that will shut down the system.

7 **ORP Sensor Meter**
Displays Oxidation-Reduction Potential of water injected with ozone, in mV.

8 **Discharge Flow Meter**
Displays flow rate of treated water exiting the OzonePro System in LPM.

9 **OzonePro System Control Power Switch**
This switch must be turned on for the OzonePro System to run.

10 **Air Compressor**
Takes in ambient air, dries it and sends it to the O2 generator.

11 **Water Pump**
Circulates water to be treated through the venturi injector so that ozone can be injected into the water line. The pump size will be different depending on the application; three-phase 208/230 VAC or 480 VAC versions are available.

12 **Water Pump Header**
Inlet where water enters the OzonePro System.

13 **Water Inlet Isolation Valve**
This valve is for long-term shutdown and must be open for the OzonePro System to function properly. This valve is not interlocked; running the system with this valve closed may damage the pump.

14 **Water Pump Power Interlock Switch**
Switch must be turned to On position to start the pump.

7. OzonePro System Exterior - Back

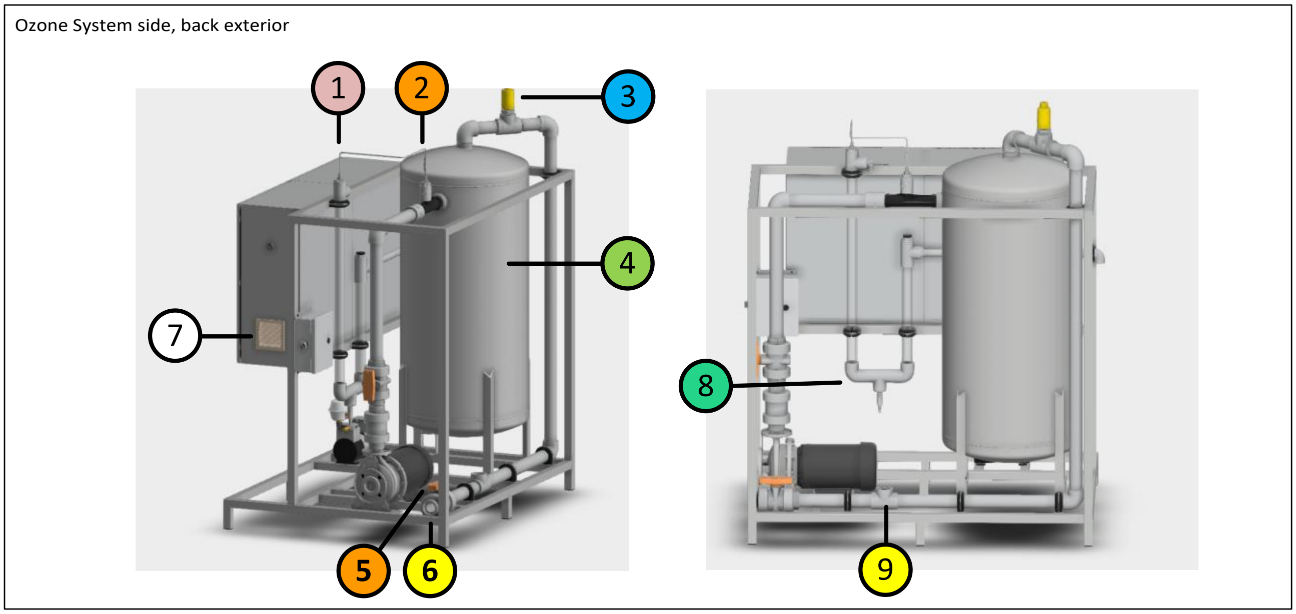


Figure 4: Ozone System side and back exterior

1 Ozone Injection Tube Inlet
Connection point where O3 enters the injection tube.

2 Ozone Injection
Venturi connection point where O3 is injected into the water stream.

3 ORP Sensor
The Oxidation-Reduction Potential sensor reads the dissolved ozone in the water discharging from the mixing tank. The ORP reading correlates with very rapid water disinfection by ozone. The reading is also used to adjust the amount of ozone injected into the water stream; higher levels of oxygen indicate a lower population of organic contaminants (which are consuming less oxygen), in which case the OzonePro System will decrease the injection rate.

4 Mixing Tank
80-gallon stainless steel vortex blending tank where injected ozone dissolves into the water, rapidly killing bacteria, viruses and algae as it travels through the system.

5 Water Discharge Isolation Valve

This valve is for long-term shutdown and/or maintenance of the system, and must be open for the OzonePro System to function properly. This valve is not interlocked; running the system with this valve closed may damage the pump.

6 OzonePro System Water Discharge

The piping connection point where treated water exits the OzonePro System, traveling toward the collection tank.

7 Enclosure Air Intake Filter

The combined enclosures is cooled through two filtered vents. The inlet vent is shown here, and the fan-driven outlet vent is on the other side of the combined enclosures.

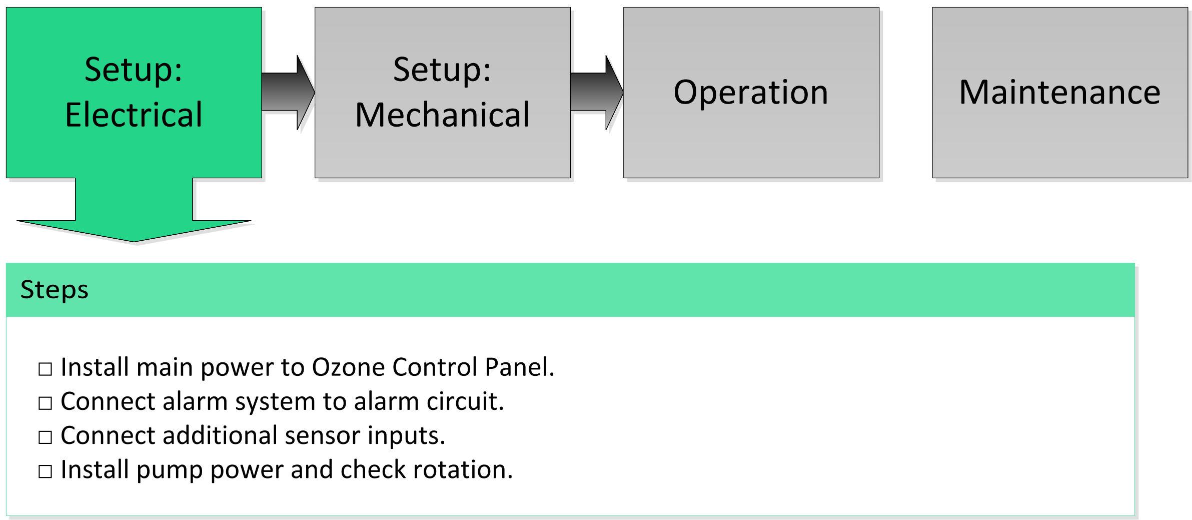
8 Ozone Injection Water Collection Trap

Provides drainage for water that might backfeed into the O3 injection line.

9 Water Discharge Flow Meter

Monitors discharge flow rate in LPM, shown on the control panel right-hand meter (#7, page 11).

8. Setup: Electrical



8.1 Installing Main Power

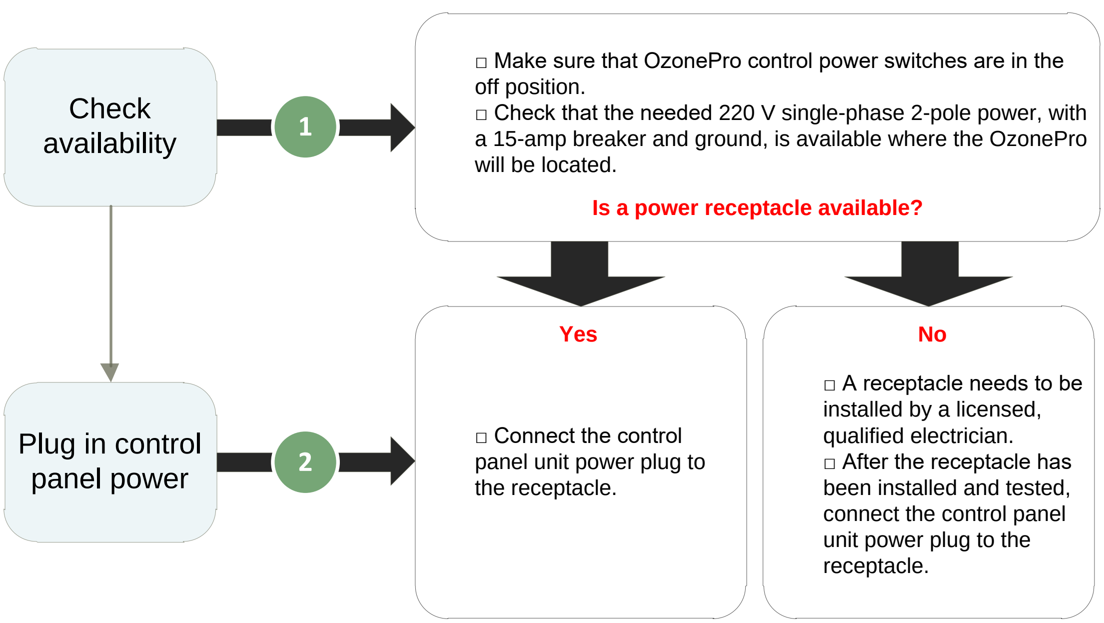


Figure 5: installing main power

1 **Check Availability:** Check that the OzonePro control power switches are in the off position. Check that the needed 220V single phase, with a 15-amp breaker, 2-pole and grounded power is available in the area where the OzonePro will be located. There should be a receptacle conforming to the appropriate type.

2 **Plug in control panel power:** If a receptacle was not available, then a qualified, licensed electrician need to install and test one. Connect the unit power plug to the receptacle.

8.2 CONNECT ALARM SYSTEM TO ALARM CIRCUIT

The OzonePro System comes with a DPDT dry contact for the alarm circuit, connected to a dedicated terminal strip located inside the O3 panel (max voltage 250 Vac, 125 Vdc, max current 5A). The on-site alarming system should be connected to terminals **3230** and **3240** on the yellow block, in the location shown:

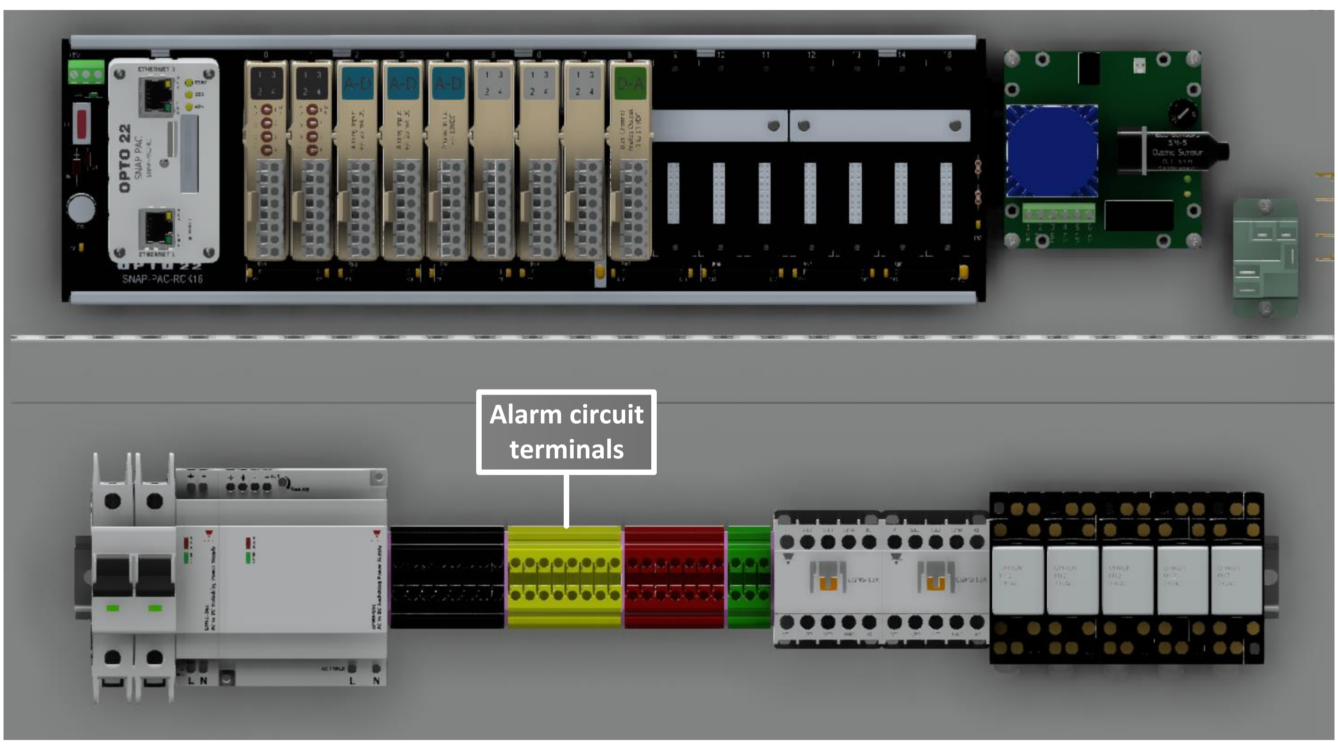


Figure 6: location of alarm circuit

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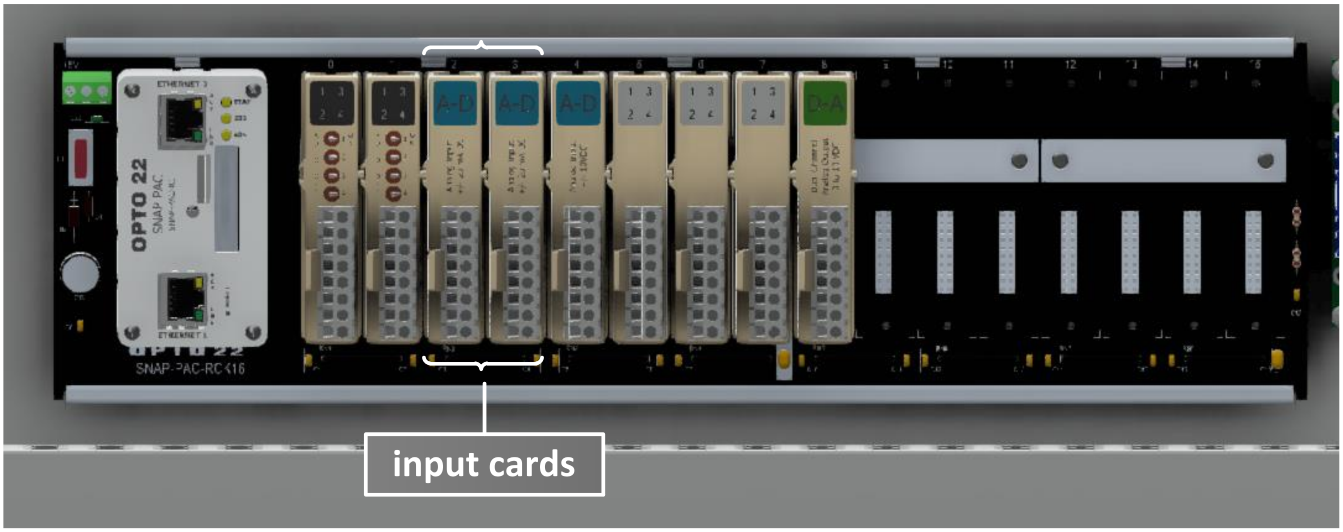
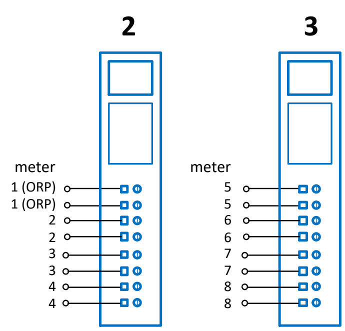
8.3 Connect Additional Sensor Inputs

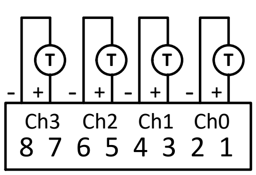
The OzonePro Sytem comes standard with two SNAP-AIMA-4 input cards, one of which has one channel dedicated to the ORP sensor. If an application requires additional sensors, they can be connected to the remaining channels on the input card, and additional input cards if available. Then, the software can be configured to read and display the inputs as Assignable Meters (see #2, p. 25).



Each input card has four channels, and can manage up to four meters and their sensors. Channel one of the input card in slot 2 is dedicated to the ORP sensor and cannot be changed.



Meters are assignable from the OzonePro software.



Self-powered transmitters

The input cards can be wired to field devices in one of two ways shown at left. Note that terminals 2, 4, 6, 8 are connected internally.

Figure 7: adding additional inputs to input cards

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8.4 Install Pump Power and Check Rotation

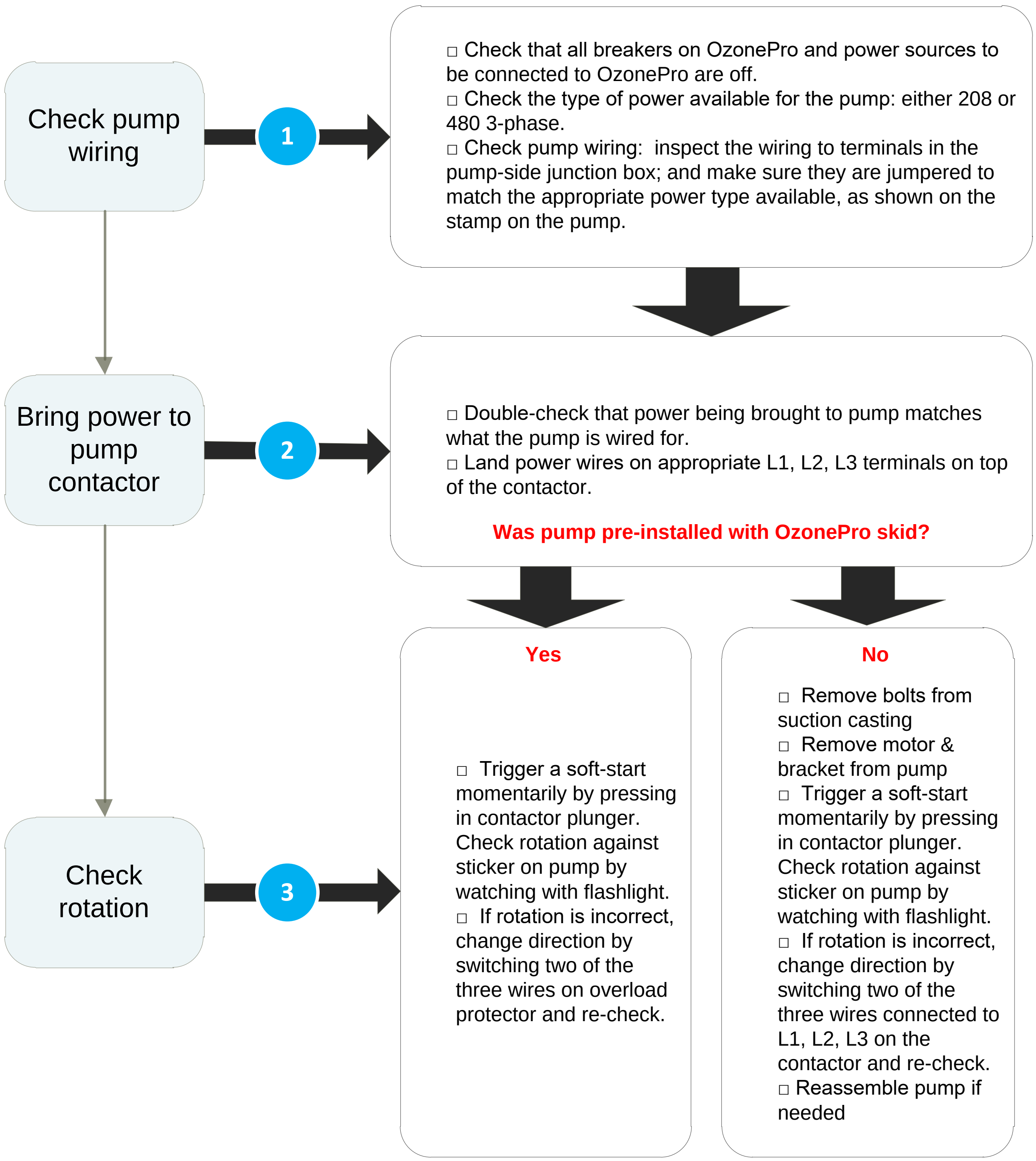


Figure 8: installing pump power and checking rotation

1

Check Pump Wiring:

- ☐ Make sure all breakers on the OzonePro and any power sources to the OzonePro are off.
- ☐ Check the type of power available to the pump: either 208 3-phase or 480 3-phase. If coming from a panelboard external to the panel, there must be a disconnect before the pump and all must be rated for 15 amps.
- ☐ The pump must be wired to match the available power. Open the junction box on the pump and check that the wires are jumpered together in a pattern that matches the power type shown on the pump stamp. Each wire's terminal number should be clearly labeled on each wire, and should match its color according to the pump manual. In the example at right, they are jumpered with wire nuts.

Pump wiring example using wire nuts to form jumpers

2

Bring Power to Pump Contactor:

- ☐ Double-check that the power type being brought to the pump matches the wiring configuration of the pump.
- ☐ Land the power wires on the upper three **L1**, **L2**, and **L3** terminals of the contactor.
- ☐ Check that the pots on the overload relay are set properly. For 208, the adjustment dial should be 14.25, and the reset mode selector should be set to "H" for Hand.

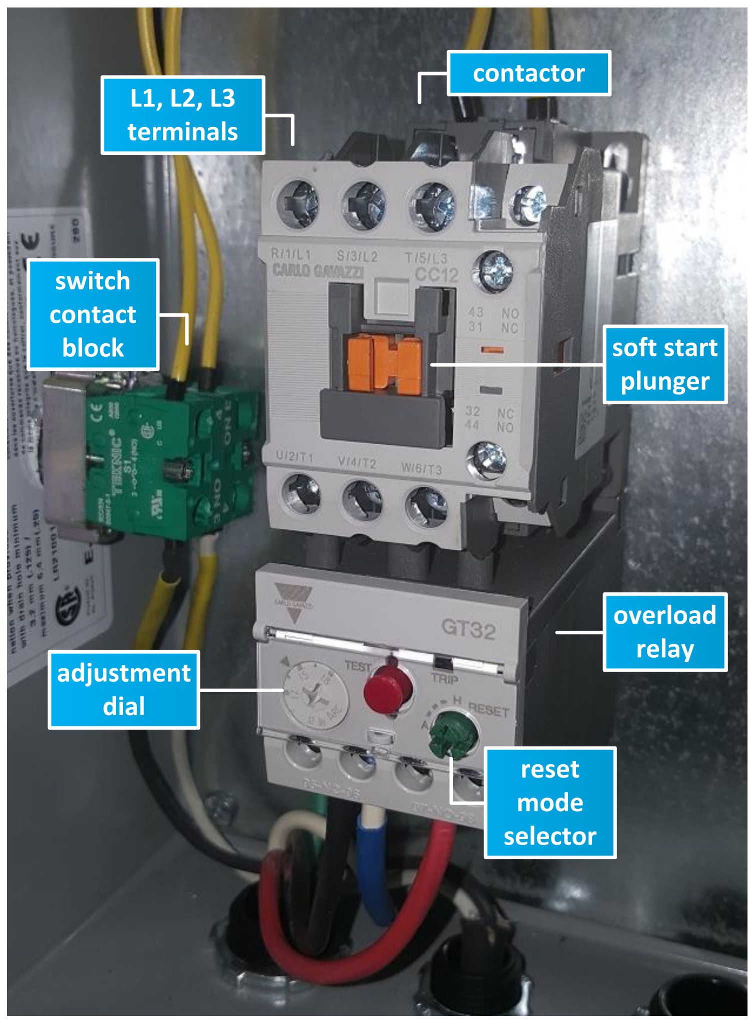


Figure 9: pump starter junction box

3

Check Pump Rotation:

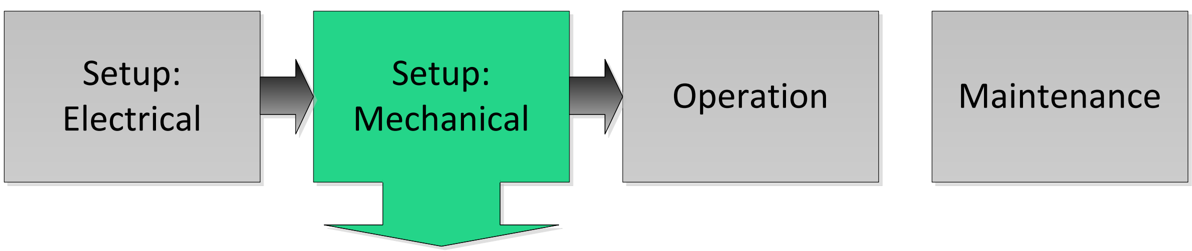
- ☐ If the pump arrived separately or not fully installed, prepare the pump for rotation check by removing bolts from the suction casting, and removing the motor and bracket from the pump.
- ☐ Check rotation by pressing the plunger on the contactor while watching spin direction with a flashlight shining through the cage. Make sure it matches the arrow on the side of the pump.
- ☐ If rotation is wrong, make sure all disconnects are switched off,

then change rotation direction by switching *any two* of the three wires on L1, L2, or L3 terminals on the top of the contactor.

- □ Check rotation again.
- □ Reassemble pump if necessary.

WARNING: ATTEMPING TO RUN THE PUMP WHEN ITS ROTATION IS INCORRECT COULD RESULT IN MAJOR DAMAGE OCCURRING.

9. SETUP: MECHANICAL



Steps

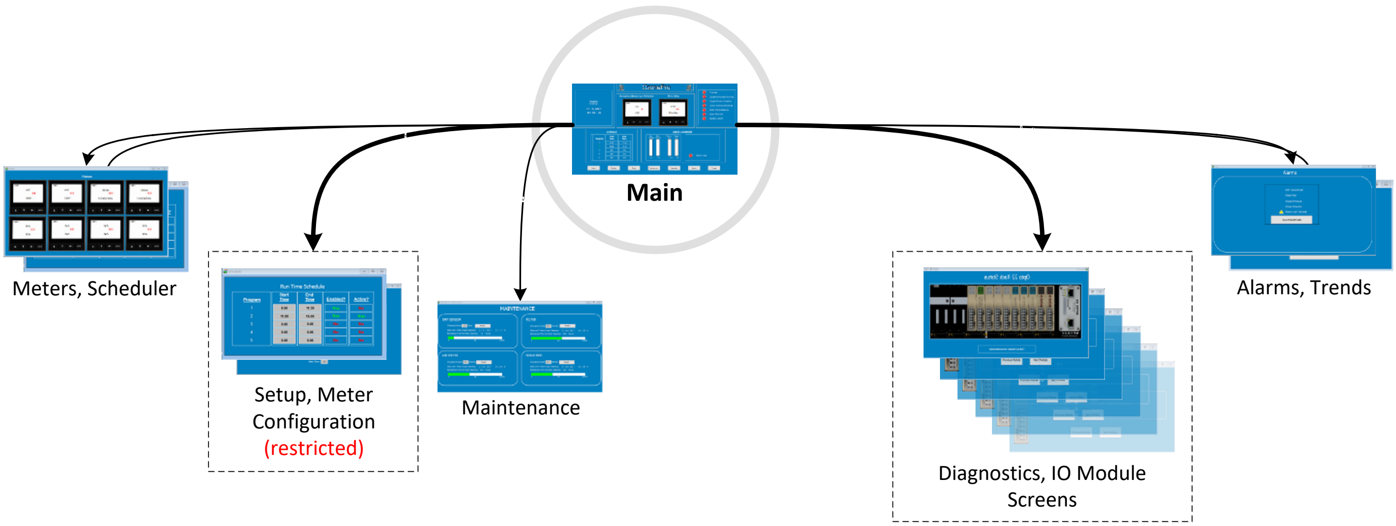
- □ Install unit in dry equipment room.
- □ Attach inlet and discharge water lines to unit.
- □ Remove blue cap from ORP sensor.

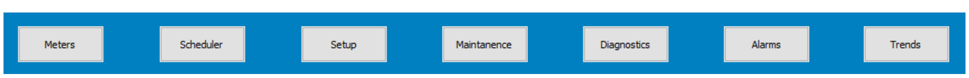
- The OzonePro unit should be installed in a dry equipment room. It is not rain or water-resistant.
- **The inlet and water discharge lines** (see #12 on page 11, and #6 on page 13 for attachment points) **should be grey PVC that is UV-rated**. A self-cleaning or media filter should be installed after the return pump (see the autobackwash filter on page 9 to verify location).
- The ORP sensor is already installed, but before first-use it needs to have a protective blue cap removed from its electrode. The electrode is attached to the ORP sensor at a point inside the pipe, so it will need to be taken out to remove the cap (see page 45 for instructions on ORP electrode removal).

10. HMI Screen Navigation

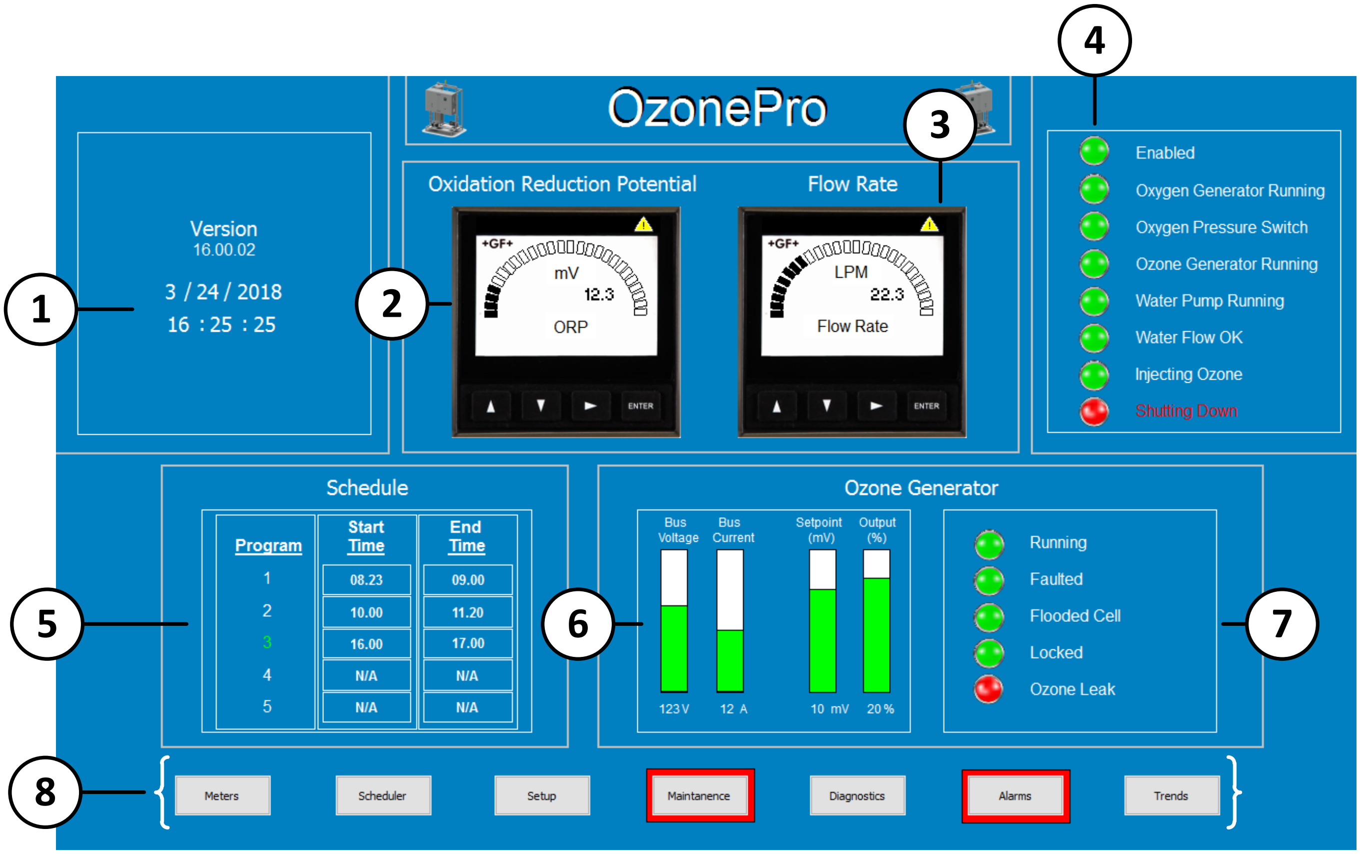
10.1 Introduction

Each of the screens below can be reached from the Main Screen, either directly by using the navigation bar along the bottom, or through a second menu screen. The Main Screen navigation bar is always visible. To exit a popup screen and return to Main, simply click on any blank area outside the popup.





10.2 Main Screen



① System Version, Date/Time

Displays the current OzonePro system version, date and time.

② ORP Sensor Display

The Oxidation-Reduction Sensor is a reproduction of a Signet 9900 SmartPro Transmitter located on the left side of the O3 Generator Control Panel enclosure (see #6, p. 11; for a guide to reading the Signet 9900, see p. 25).

③ Discharge Water Flow Rate Display

The Discharge Water Flow Sensor is a reproduction of a Signet 9900 SmartPro Transmitter located on the left side of the O3 Generator Control Panel enclosure (see #7, p. 11; for a guide to reading the Signet 9900, see p. 25).

4 System Status Box

Displays the overall system status with either the color **green** to indicate “ON” or “OK” or **red** to indicate “OFF” or “NOT OK”. The order of the lamps from top to bottom follows the startup sequence:

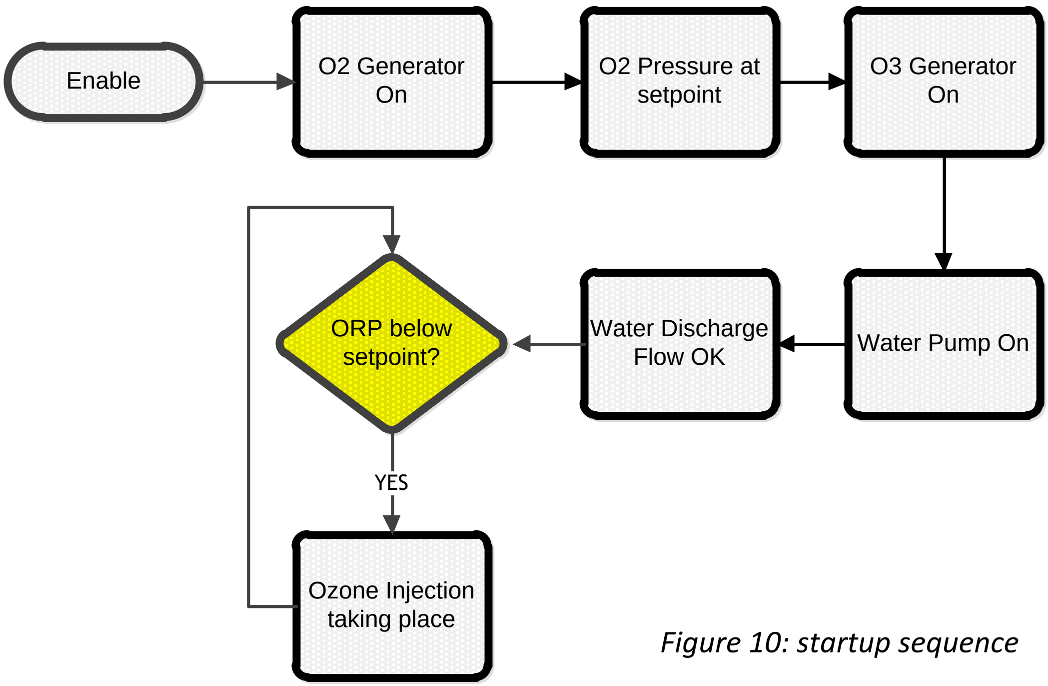


Figure 10: startup sequence

Note that the bottom lamp, **Shutting Down**, is only visible if the system has encountered a critical fault and is attempting to shut down.

5 Runtime Schedule

This is a compact, read-only status display of the Scheduler Screen (see p. 26).

6 Ozone Generator Analog Values

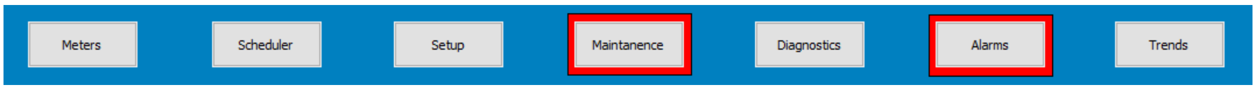
O3 Generator bus voltage, bus current, ORP setpoint and output are displayed here as easily readable green bars.

7 Ozone Generator Status

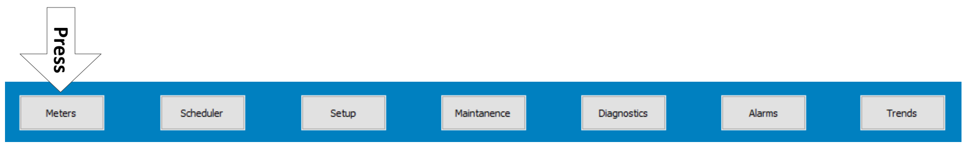
This is a compact, read-only display of the Ozone Generator Status. One of its alarms, Ozone Leak, is considered a critical alarm capable of shutting the system down, and is listed on the critical Alarms Screen on page 38.

8 Screen Navigation Buttons

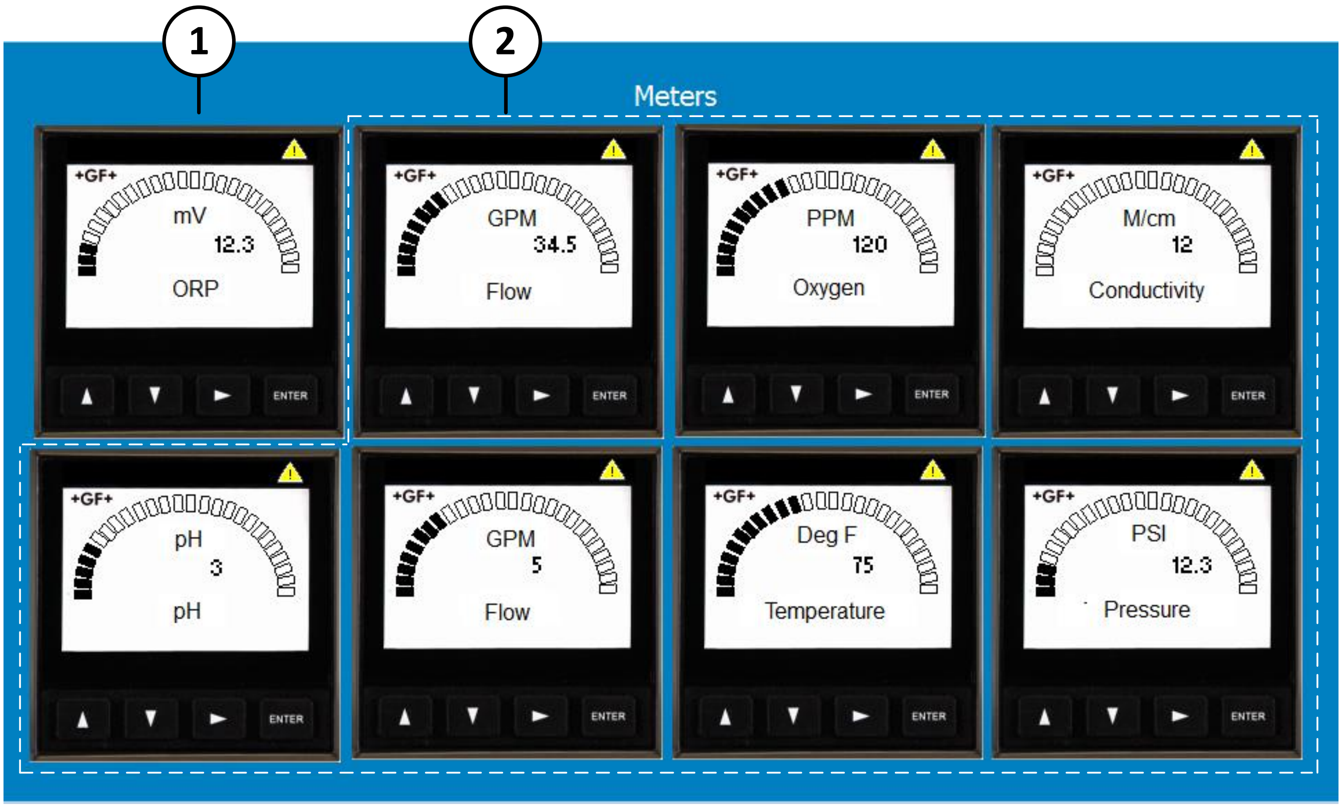
When these buttons are pressed, the Meters, Scheduler, Setup, Maintenance, Diagnostics, Alarms and Trend screens are launched. On the Maintenance button, a warning rectangle turns red and blinks in the event that a scheduled maintenance action needs to be performed; another warning rectangle on the Alarms button alerts users to the presence of any critical O3 Generator alarms.



10.3 Meters Screen



The meters on the Meters Screen can be configured to one of several possible types. The only exception is the top left, which is set to ORP and cannot be changed.



1 ORP Meter
The meter at the top left is always fixed as the ORP meter.

2 Assignable Meters
For all other meters on this screen, the type (ORP, PH, Oxygen, Conductivity, Level, Temperature, Pressure or Flow) can be assigned from the Meter Configuration Screen by entering the Legend code into Type (see p. 30).

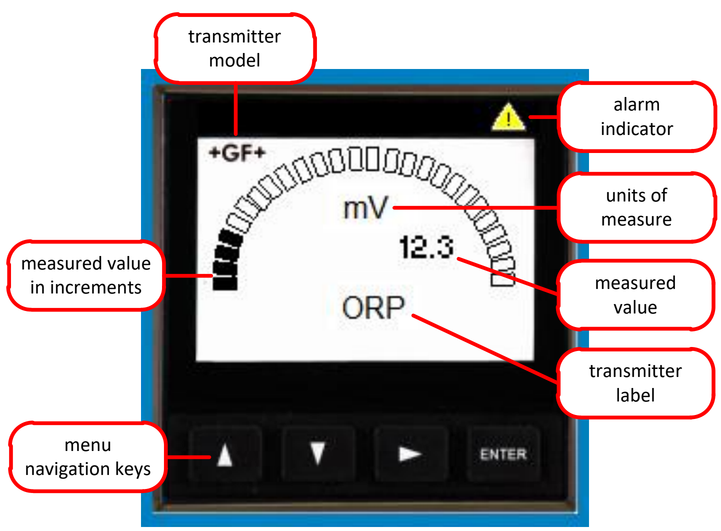


Figure 11: reading a Signet 9900 GF+ Transmitter (*note: the menu navigation keys are not active on the HMI version*).

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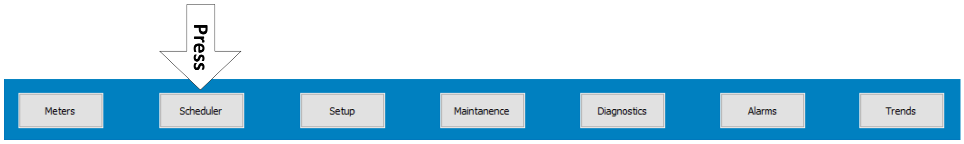
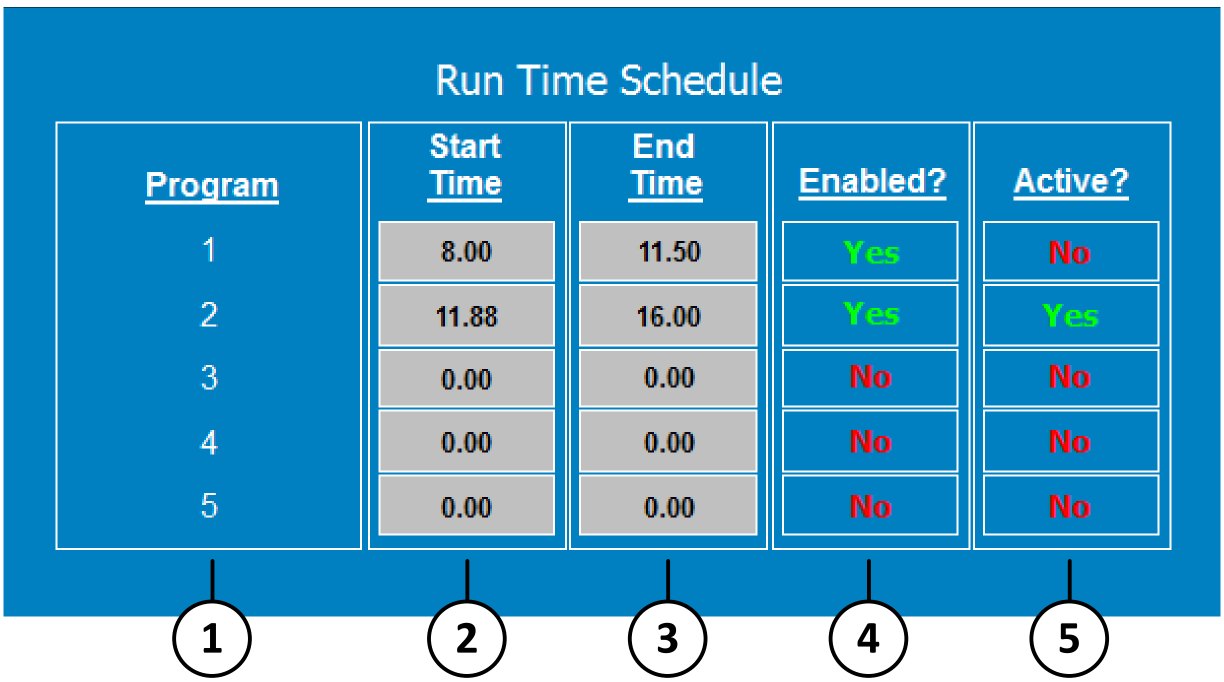
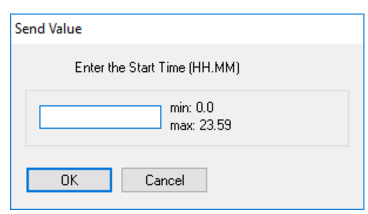
10.4 Scheduler Screen



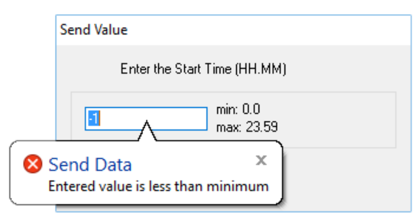
Five schedules can be programmed from this screen. As they are programmed, they instantly become enabled once Start and End times are entered. If a time window coincides with the current time, the program becomes immediately active. Programs will repeat indefinitely each day until a Start and End time of zero are entered, which will cancel the program.





1 Program Label

Up to five scheduled programs are possible. When one of the programs is Enabled and Active, the Enabled and Active columns turn green with Yes.



2 Start Time

Pressing a program's Start Time button will launch the "Send Value" popup shown at right. Time must be entered as a decimal in military time. For example, 8:00 AM would be entered as 8.00, and 8:00 PM would be entered as 20.00,

otherwise an error message is displayed, as shown at right.

3 **End Time**

The End Time buttons launch a similar popup to the Start Time, and also accept military times in decimal form. Once the Start Time and End Time is entered for a given program, that program is immediately enabled. If the current time falls within the program's Start and End times, the program immediately becomes active.

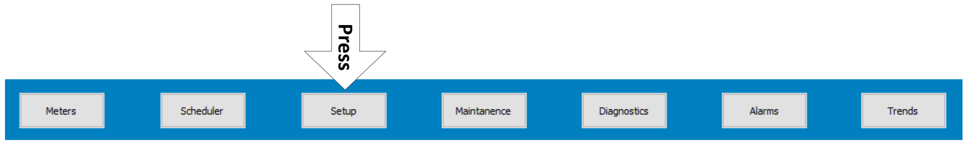
4 **Enabled? Indicator**

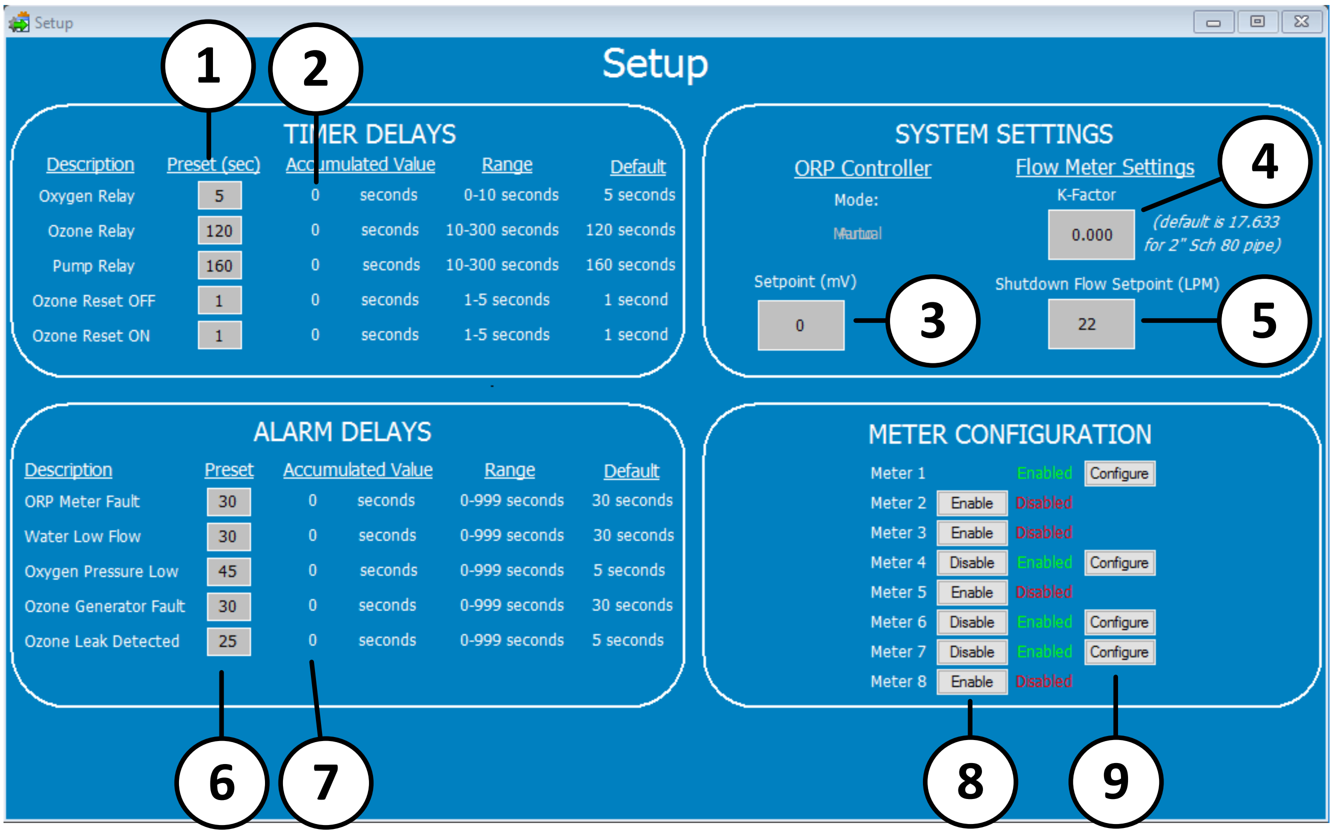
An enabled program will be displayed as a green **Yes**, or a **No** for disabled.

5 **Active? Indicator**

An active program will be displayed as a green **Yes**, or a **No** for disabled.

10.5 SETUP SCREEN (PASSWORD-PROTECTED)





① Startup Sequence Delays

The five timer delays affect control program startup sequencing, and are available for system optimizing. The pump relay may be a focus as the necessary delay time will be affected by pump selection. Range and default settings are listed at right.

② Accumulated Value

When adjusting the startup sequence delays, the timer status can be viewed here.

3 **ORP Setpoint (mV)**

Press to set O3 level. The system will vary ozone injection to maintain that level, as measured by the ORP sensor.

4 **Flow Meter K-Factor**

When pressed, allows user to change the K-factor. The K-factor is the expected number of pulses to be produced by each volumetric unit of fluid that passes through the flow meter, and provides the means to interprete the pulses as flow. An altered K-factor can be used to adapt the sensor to the specific installation for uniformity of measurement.

5 **Flow Meter Shutdown Flow Setpoint**

Press to set minimum discharge flow level, below which the system will attempt to shut down.

6 **Critical Alarm Delay**

The critical alarms listed here will initiate shutdown when they are triggered. Adjusting alarm delays will accommodate unique installation considerations. Range and default settings are listed at right.

7 **Accumulated Value**

When adjusting the critical alarm delays, the timer status can be viewed here.

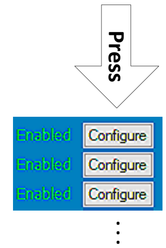
8 **Meter Enable/Disable buttons**

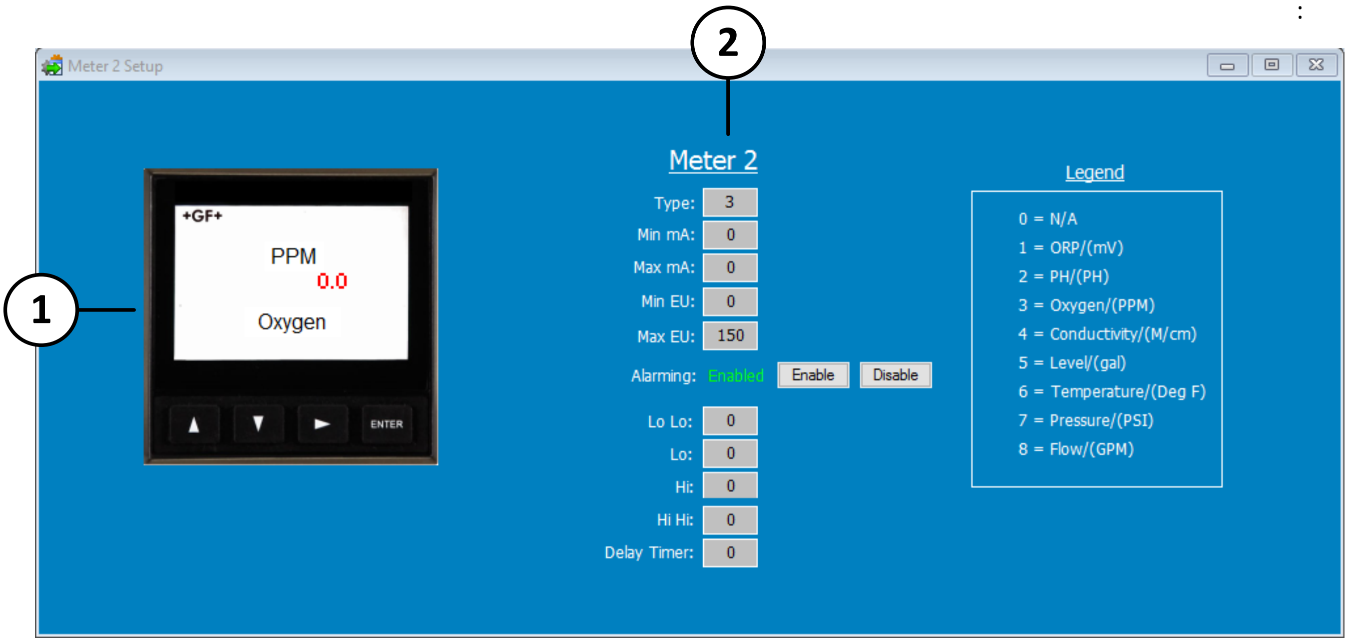
Pressing these buttons will enable or disable the meters displayed on the Meters Screen (see p. 25).

9 **Meter Configuration buttons**

Pressing these buttons will launch the meter configuration screen (see Meter Configuration Screen, p. 30), allowing operators complete control over all meters displayed on the Meters screen (see p. 25) except the ORP meter displayed in the top left.

10.6 Meter Configuration Screen (Password-Protected)





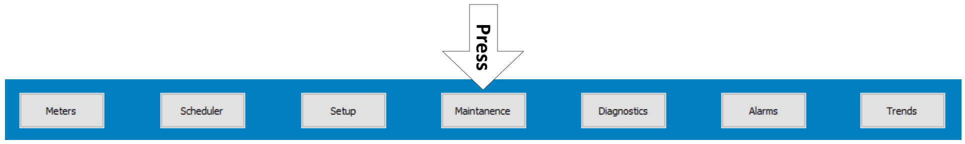
(1) **Meter Display**

The selected Signet 9900 GF+ meter is displayed with live values. On the configuration screens, the meters are given generic reference numbers (1, 2, 3…). For information on reading the meters, see p. 30.

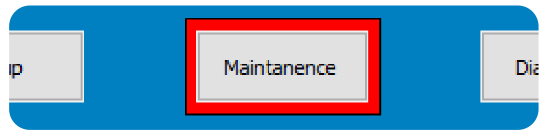
(2) **Meter Configuration Parameters**

Each parameter can be adjusted to correspond to the application for a given meter/transmitter by pressing one of the grey squares. Parameters include:

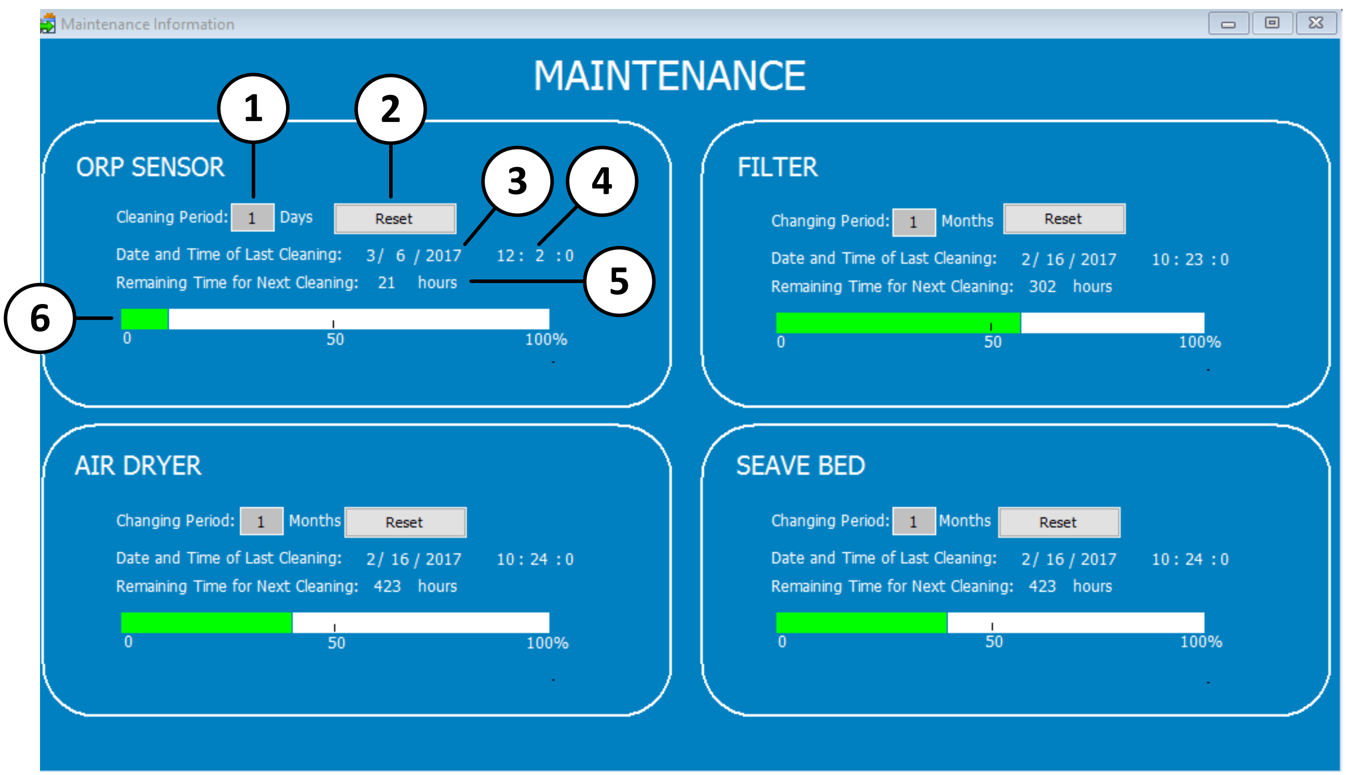
- Type: select a number from the Legend box at right to change the meter type. Labeling and Engineering Units will automatically be updated.
- Min mA: changes the lower milliamp input range (usually 4mA).
- Max mA: changes the upper milliamp input range (usually 20mA).
- Min EU: changes the lower Engineering Units
- Max EU: changes the upper Engineering Units
- Enable/disable alarming
- Alarms section: Lo Lo, Lo, Hi, Hi Hi, and the individual meter's alarm delay timer can be adjusted.



10.7 Maintenance Screen



The Maintenance Screen is for creating customizable, automated equipment maintenance plans, which will trigger reminders at a time set by the operator. Reminders are indicated by a flashing red rectangle around the navigation button. The four equipment areas represented on the Maintenance Screen are ORP Sensor, Filter, Air Dryer and Sieve Bed. All four have the same configuration options.



1 **Cleaning Period**

Pressing this button allows the operator to set the number of days before the next maintenance action.

2 **Reset Button**

After performing a maintenance action, pressing this button will set the countdown timer back to zero. The timer will immediately return to counting down the number of days before issuing the next maintenance reminder.

3 **Date of Last Cleaning**

When the Reset Button is pressed, the date is committed to memory and displayed here.

4 **Time of Last Cleaning**

When the Reset Button is pressed, a the time is committed to memory and displayed here.

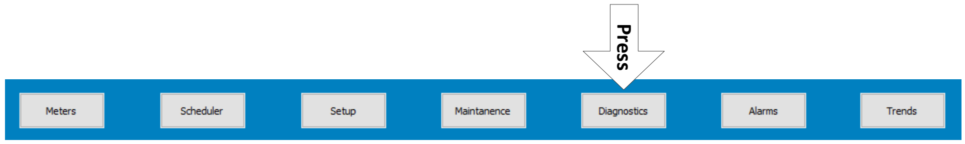
5 **Remaining Time for Next Cleaning**

The number of hours until the next maintenance action is calculated and displayed here.

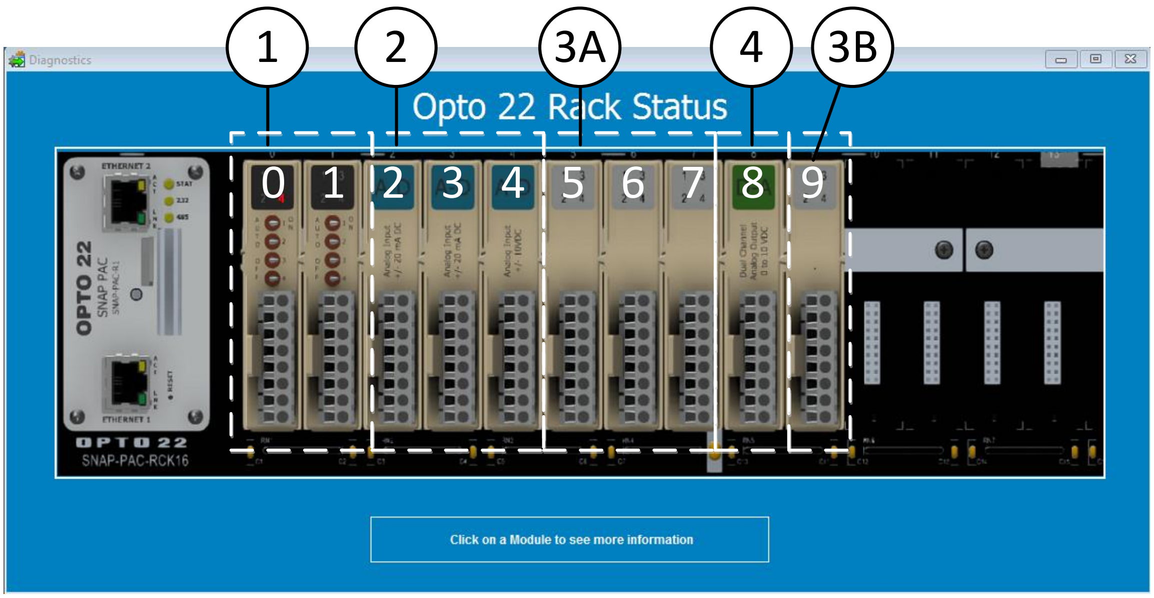
6 **Maintenance Action Time Span Bar**

This horizontal bar displays the use-life consumed (in the case of a filter), or the percentage of time elapsed until the next maintenance action.

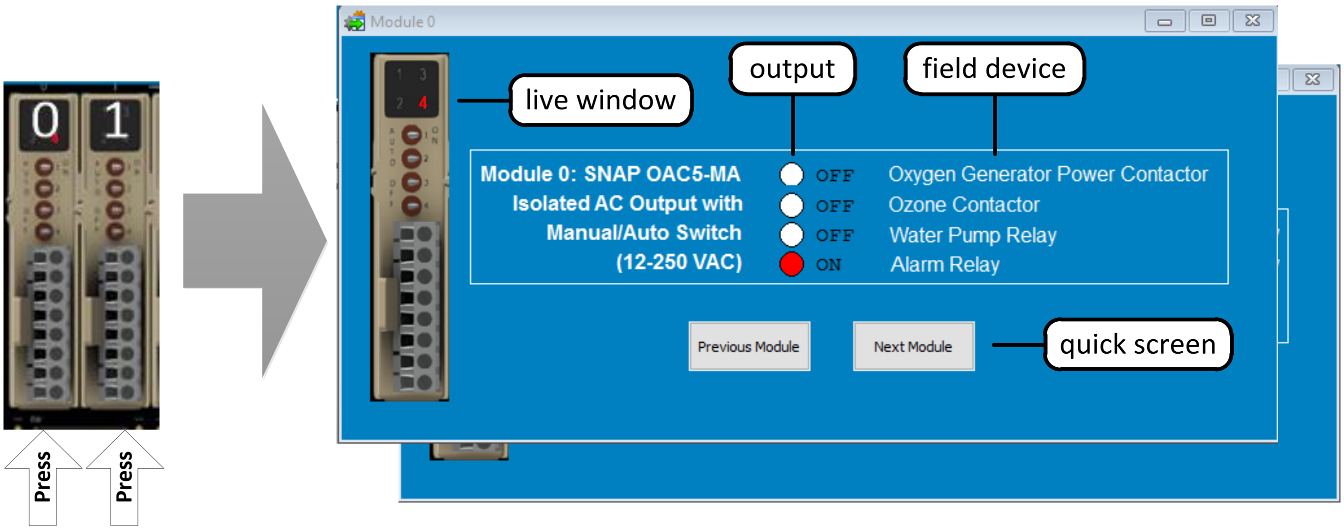
10.8 Diagnostics Screen



The Diagnostic Screen shows the Opto22 Rack enclosed in the O3 Generator Control Panel. Users can press the 10 I/O modules in the picture to view a popup with module details. For detailed I/O card assignments, see Appendix A, p. 48.



① Digital Output Module Detail Screens (modules 0, 1)

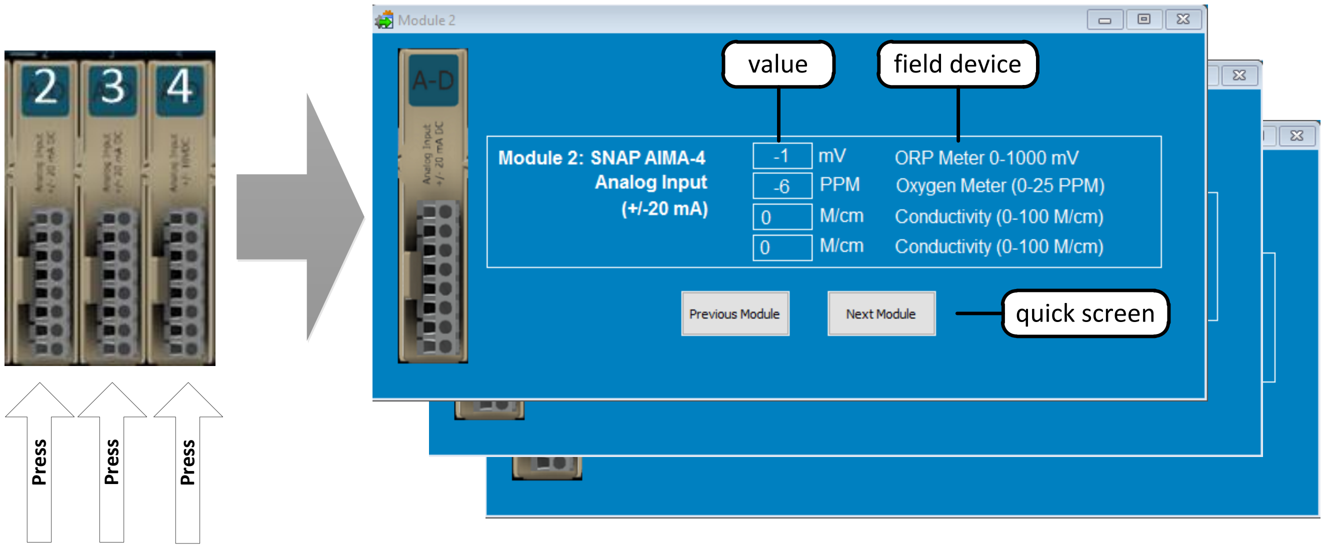


Press either module to open a Digital Output detail screen for that module.

Features:

- **Live Window**: output values are also shown in a live screen on the module window, as they appear in the rack module. A red 1, 2, 3, or 4 indicates a channel is on.
- **Output**: actual output values are shown.
- **Field Device**: field device labels for the four channels.
- **Quick Screen**: Previous and Next module buttons are available to quickly cycle to the next module.

(2) Analog Input Module Detail Screens (modules 2, 3, 4)

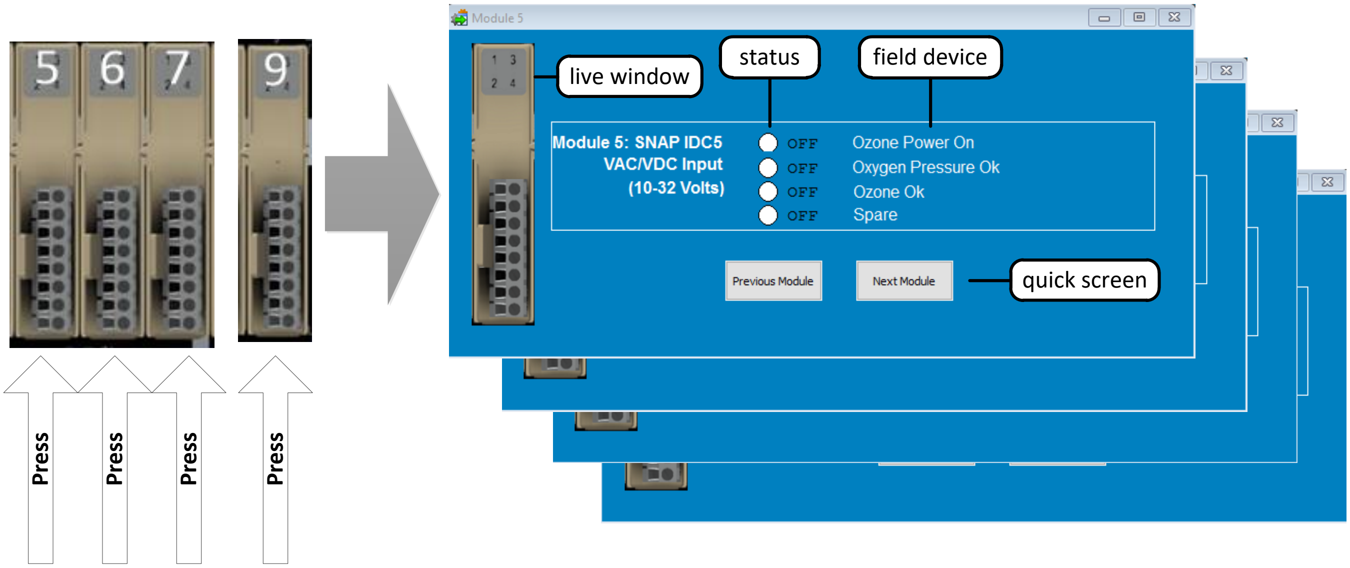


Press any module to open an Analog Input detail screen for that module.

Features:

- **Values**: actual input values are shown.
- **Field Device**: field device labels for the four channels.
- **Quick Screen**: Previous and Next module buttons are available to quickly cycle to the next module.

3A 3B Digital Input Module Detail Screens (modules 5, 6, 7, 9)

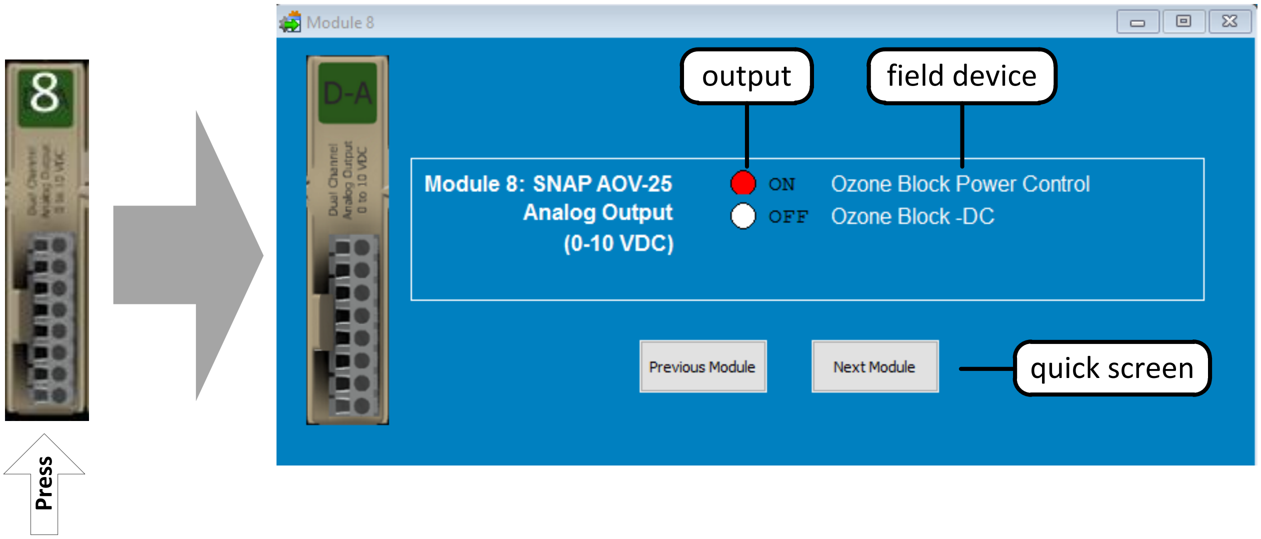


Press any module to open a Digital Input detail screen for that module.

Features:

- **Live Window**: output values are shown in a live screen on the module window, as they appear in the rack module. A red 1, 2, 3, or 4 indicates a channel is on.
- **Output**: actual output values are shown.
- **Field Device**: field device labels for the four channels.
- **Quick Screen**: Previous and Next module buttons are available to quickly cycle to the next module.

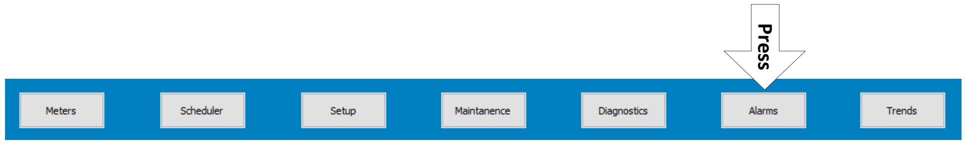
4 Analog Output Module Detail Screen (module 8)



Press module to open an Analog Output detail screen for that module.

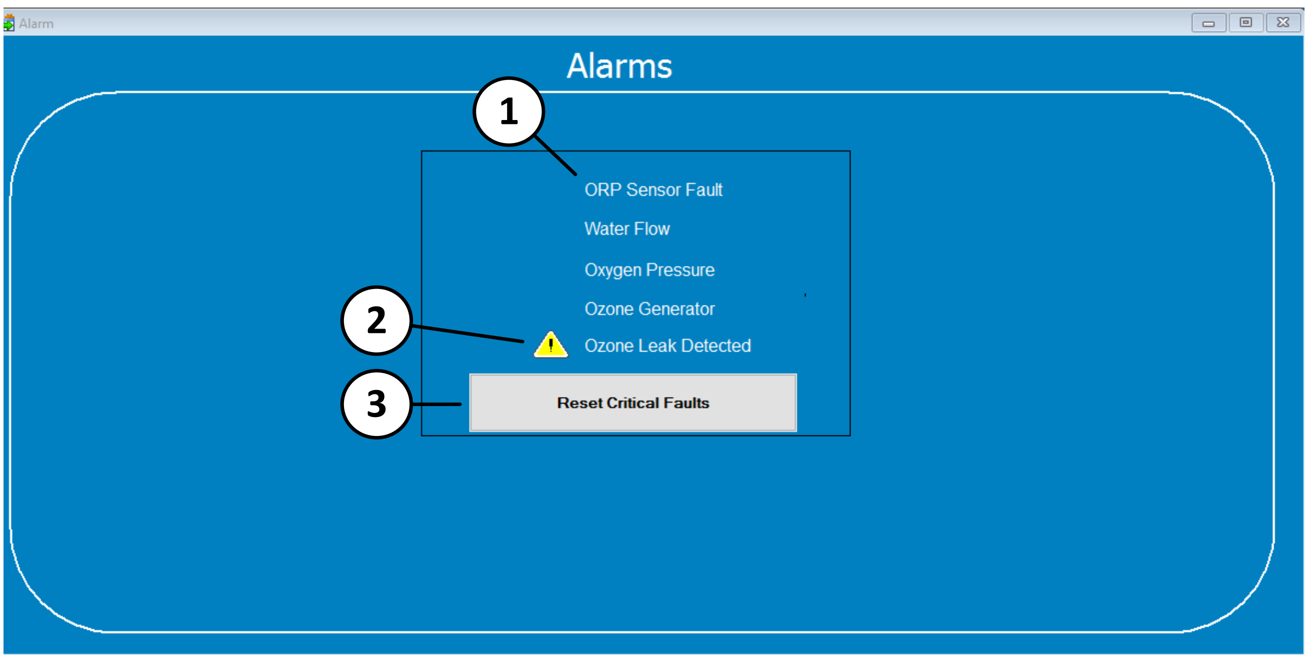
Features:

- **Output**: actual output values are shown.
- **Field Device**: field device labels for the four channels.
- **Quick Screen**: Previous and Next module buttons are available to quickly cycle to the next module.



10.9 Alarms Summary

The presence of a critical system alarm is indicated by a flashing red rectangle around the Alarms Summary Screen navigation button on the lower strip. Press this button to navigate to the Alarms Summary Screen. The Alarms Summary Screen shows the status of the possible alarms and allows users to reset them.



1 **Alarms List**

The five critical Ozone Generator alarms are always shown here: ORP Sensor Fault, Water Flow, Oxygen Pressure, Ozone Generator fault, and Ozone Leak Detected. For help diagnosing these alarms, see the section “OzonePro System HMI Alarms and Recommended Qualified Technician Response Actions” in the Troubleshooting section of this manual (p. 43).

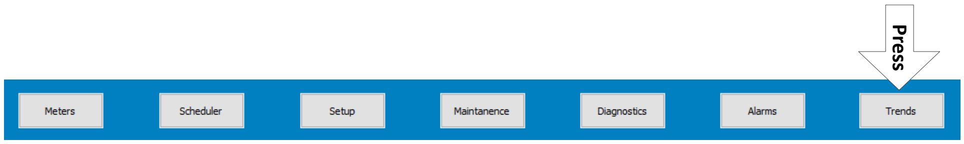
2 **Alarm Indicator**

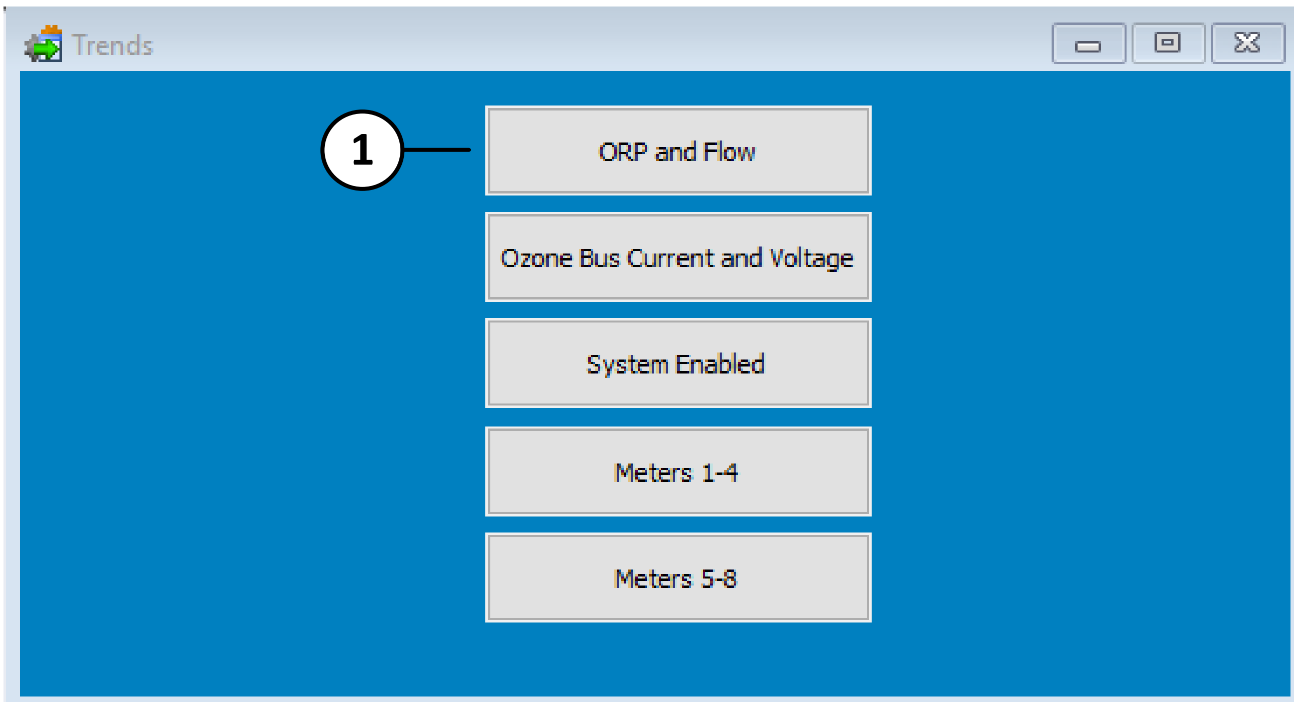
When one of the criticial alarms has recently been active, a yellow triangle symbol is shown next to it.

3 Reset Critical Faults

Pressing this button will clear inactive alarms.

10.10 TRENDS MENU

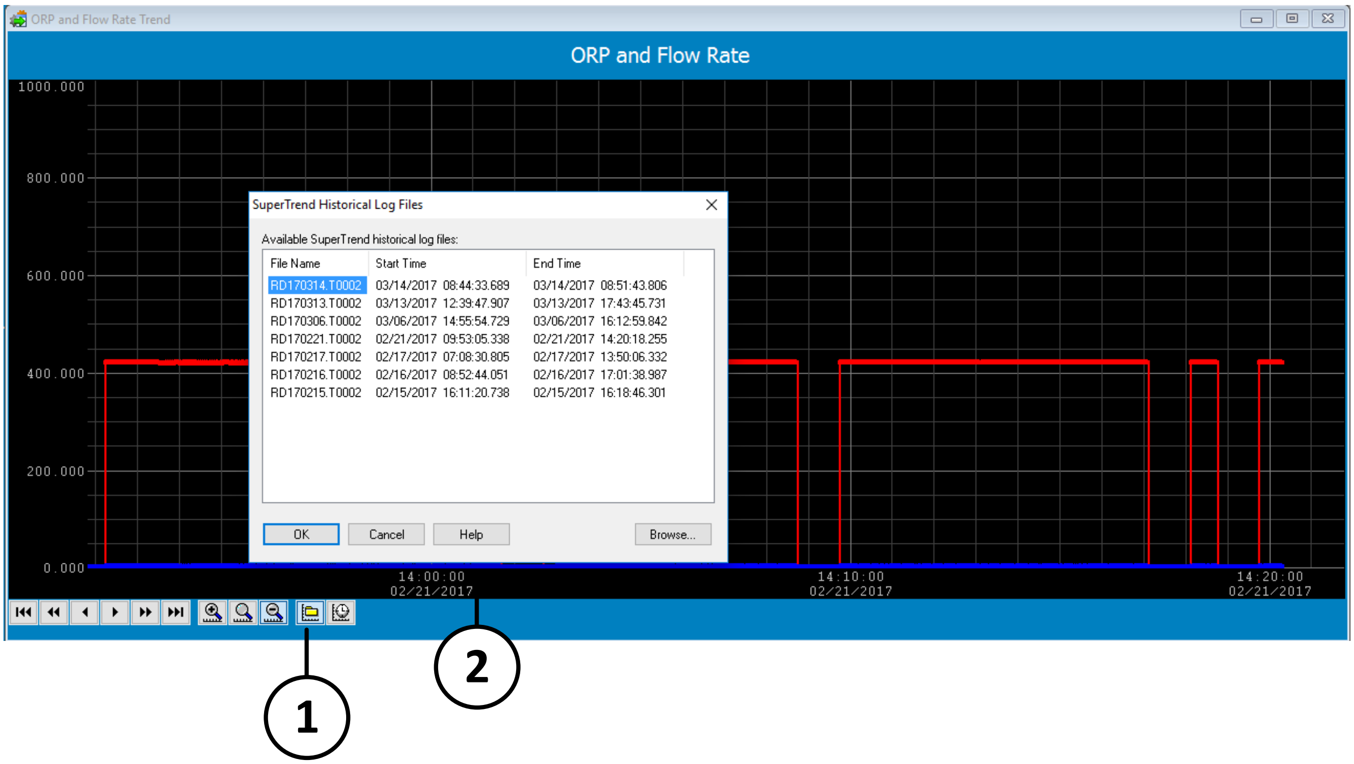




1 Trend Menu Buttons

There are five trends that can be launched from this screen: ORP and Flow, Ozone Bus Current and Voltage, System Enabled, Meters 1-4, and Meters 5-8. Once a trend screen is launched, the user must select a historical log file to view by pressing the Load Chart Button (see #1, p. 40).

10.11 Trends: Selecting Trend Log Files



1 **Load Chart Button**
Pressing this button launches the SuperTrend Historical Log Files Popup.

2 **SuperTrend Historical Log Files Popup**
Allows the operator to browse to and load one of the stored 24-hour span historical log files.

10.12 Trends: Using The Trend Toolbar

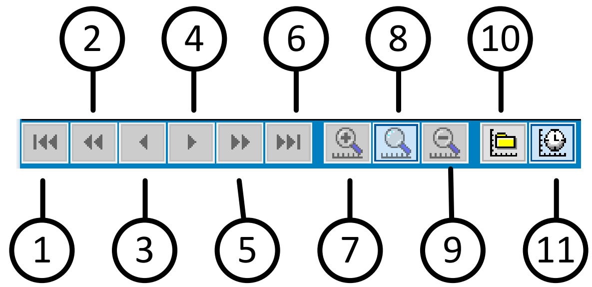


Figure 12: trend toolbar

(1) **Beginning of Log**
Moves timeline to beginning of log file.

(2) **Date/Time Move Backward**
Moves timeline backward by one day when in Full Centered View, by 30 seconds when in 30 Second View, or by 30 minutes when in 30 Minute View.

(3) **Time Move Backward**
Moves timeline backward by two hours when in Full Centered View, by 10 seconds when in 30 Second View, or by 10 minutes when in 30 Minute View.

(4) **Time Move Forward**
Moves timeline forward by two hours when in Full Centered View, by 10 seconds when in 30 Second View, or by 10 minutes when in 30 Minute View.

(5) **Date/Time Move Forward**
Moves timeline forward by one day when in Full Centered View, by 30 seconds when in 30 Second View, or by 30 minutes when in 30 Minute View.

(6) **End of Log**
Moves timeline to end of log file.

(7) **30 Second View**
Shifts timeline duration to 30 seconds.

(8) **Full Centered Timeline View**
Shifts timeline duration to 24 hours.

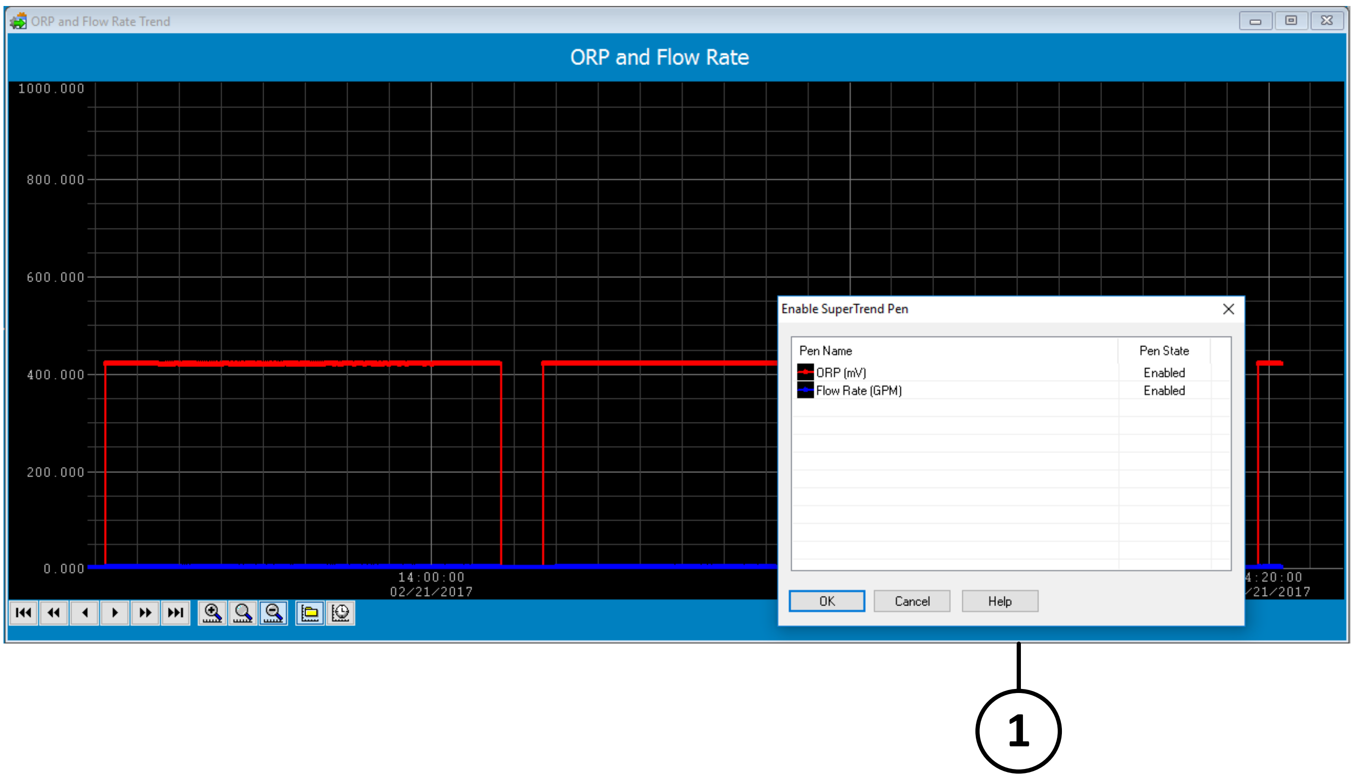
(9) **30 Minute View**
Shifts timeline duration to 30 minutes.

(10) **Load Chart**
Operator can browse to and load one of the stored 24-hour span historical log files.

11 Unload Chart

Pushing this button will unload the chart and render all buttons inactive except #10, the Load Chart button.

10.13 TRENDS: SELECTING TREND PENS



1 Pen Selection Popup

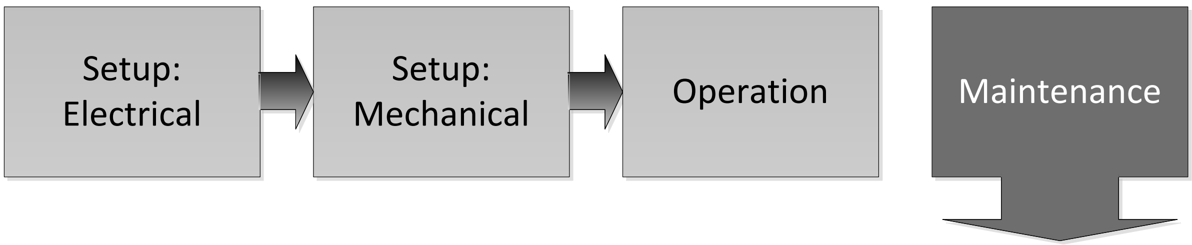
Right click anywhere on a trend to launch the Pen Selection Popup. This popup displays what the pen colors represent, and when launched it indicates whether the pens are enabled. By clicking on them, they can be made visible or hidden to isolate a trace.

11. TROUBLESHOOTING

11.1 OZONEPRO SYSTEM HMI ALARMS and Recommended Qualified Technician Response Actions

Alarm	Cause	Technician Action
ORP Sensor Fault	The ORP sensor (see #3, p. 13) has been out of range for longer than the user-configured ORP Meter Fault Alarm Delay (see #11 on the Setup Screen, p. 28). The ORP Sensor acceptable range is **-5** (~4mA) to **1005** (~20mA).	
Water Flow	The water discharge flow sensor (see #8, p. 13) has been below the Shutdown Flow Setpoint (see #4, p. 28) for longer than the user-configured Water Low Flow Alarm Delay (see #11 on the Setup Screen, p. 28).	
Oxygen Pressure	The system is enabled, the O2 generator contactor is on, and the O2 pressure switch has been off for longer than the user-configured Oxygen Pressure Low Alarm Delay (see #11 on the Setup Screen, p. 28). The O2 pressure switch is set to turn off at a low of **2 psi**.	The ozone generator will not turn back on until O2 pressure has been restored to a normal pressure of 10-15 psi.
Ozone Generator	The system is enabled, the O3 generator contactor is on, and the O3 Fault Feedback has been on for longer than the user-configured Ozone Generator Fault Alarm Delay (see #11 on the Setup Screen, p. 28).	
Ozone Leak Detected	If an O3 leak detected condition has been present for longer than the user-configured Ozone Leak Detected Alarm Day (see #11 on the Setup Screen, 28).	The only remedy is to provide an influx of fresh air to clear the ambient ozone.

12. Maintenance

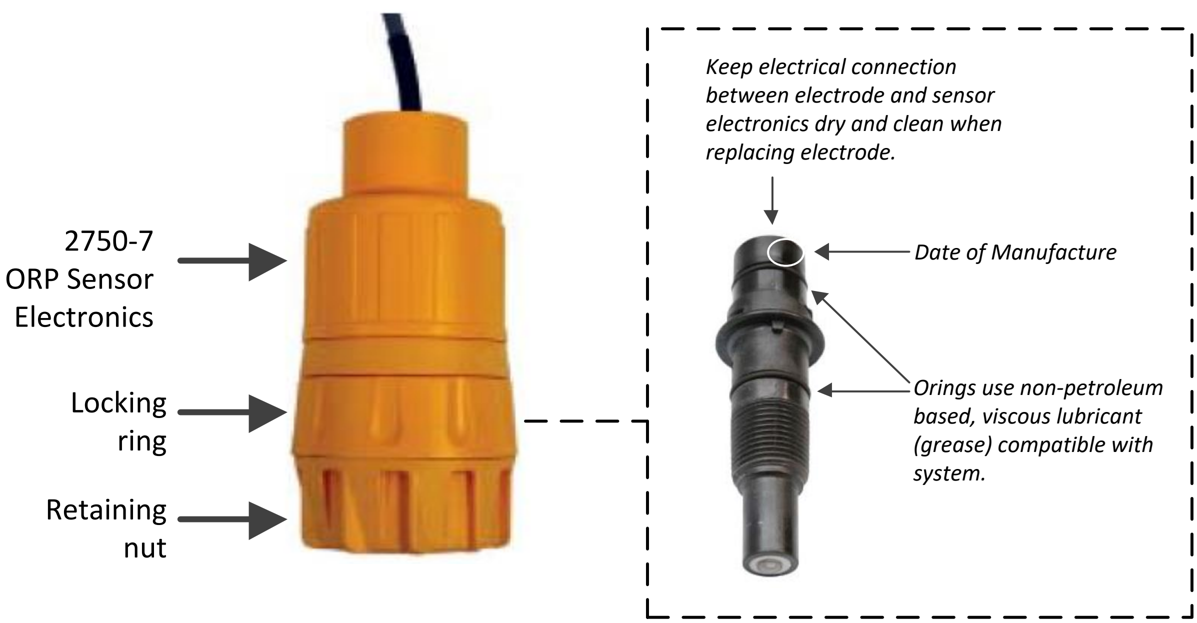


Maintenance Actions

- □ ORP Sensor Maintenance
- □ Enclosure Fan Filter Maintenance
- □ Check barometer water level (some models)

12.1 ORP Sensor Maintenance

The +GF+ 2750-7 ORP Sensor electronics module uses a Signet 2725 ORP Electrode, and displays values on the combination 9900 Transmitter/Display. The 2725 Electrode has a lifespan of 12-18 months from its date of manufacture regardless of whether it is used. During that lifespan, it should be calibrated every 4 months of continuous use, and cleaned if necessary.



2725 Flat Glass ORP Electrode

Figure 13: the ORP sensor and electrode

Materials needed:

- A prepared calibration solution using 1/8 g quinhydrone mixed with either 50 mL of pH 4 buffer (which will read 87 mV) or 50 mL of pH 7 buffer (which will read 264 mV).
- **OR** premixed Light's Solution (rated for 476 mV) can be used instead.

With the OzonePro unit shut down, close off the inlet isolation valve (see #12, p. 11), then slowly close the discharge isolation valve (see #5, p. 13). Remove the ORP electrode (#3, p. 13) following the steps below:

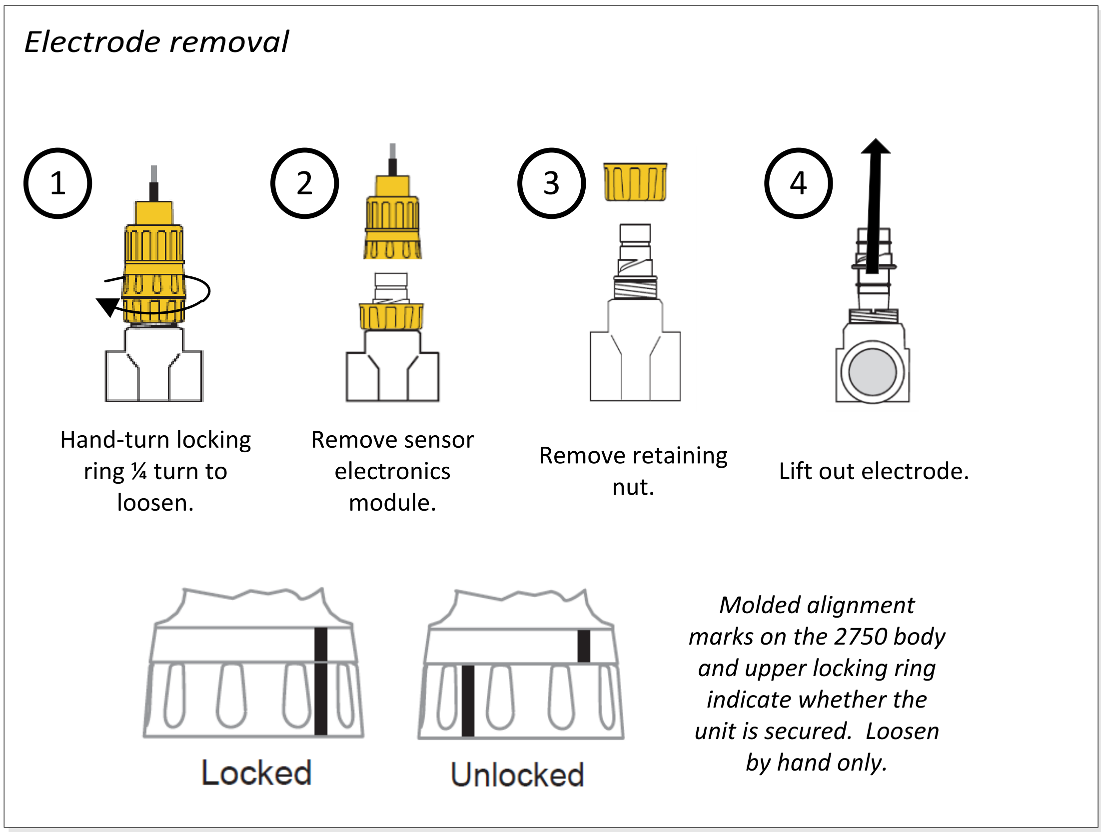


Figure 14: ORP sensor electrode removal

Check that no more than 18 months have elapsed since the electrode date of manufacture (stamped above the top O-ring of the electrode). If more than 18 months have elapsed, the electrode needs to be replaced. The stamp is a letter and number, and follows the chart below:

Letter	**N**	**M**	**L**	**K**	**J**	**H**	**G**	**F**	**E**	**D**	**C**	**B**
Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
#	**5**	**6**	**7**	**8**	**9**	**0**	**1**	**2**	**3**	**4**	**5**	**6**
Year (20xx)	10	11	12	13	14	15	16	17	18	19	20	21

For example, a stamp of "**K3**" would mean the electrode was made in **April, 2018**.

Temporarily reassemble the electrode and ORP sensor electronics module outside the pipe, and locate the +GF+ Signet 9900 ORP transmitter display on the front of the OzonePro unit (see #6, p. 11). To perform an EasyCal, perform the following steps:

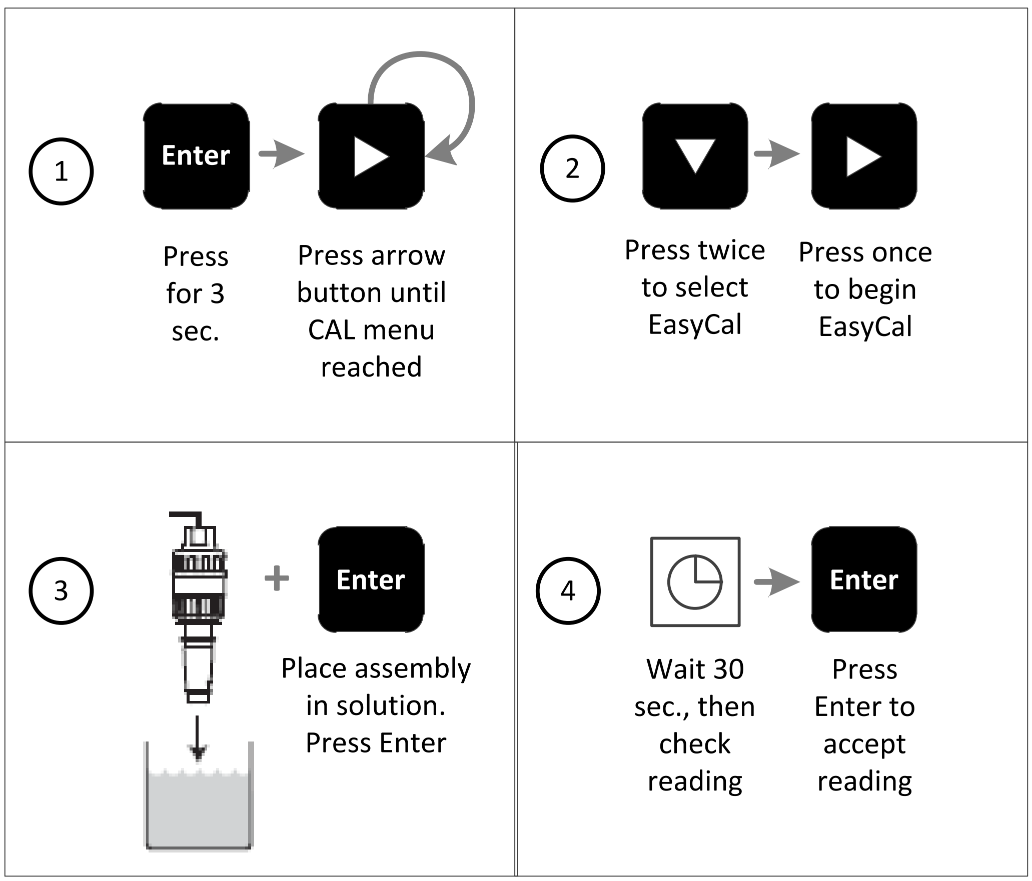


Figure 15: calibration steps

Solution	Acceptable Reading (± 80 mV)
7pH buffer +quinhydrone	87 mV
4pH buffer +quinhydrone	264 mV
Light's Solution	476 mV

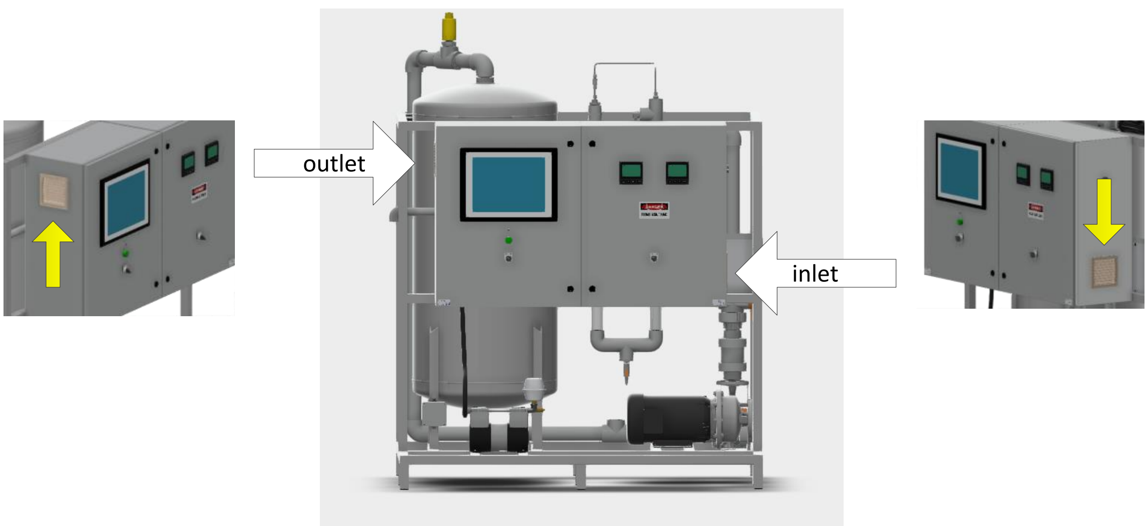
Reinstall the electrode by reversing the removal steps. (For more information, see the following documents: "*Signet 2724-2726 and 2734-2736 Series DryLoc pH and ORP Electrodes (3-*

2724.090, Rev L 10/16),” “Signet 9900 Transmitter (3-9900.090 Rev F 10/15),” and *“Signet 2750 DryLoc pH/ORP Sensor Electronics (3-2750.090 Rev N 10/16).”*

12.2 Enclosure Fan Filter Maintenance

Twice a year, the Pfannenberg fan filters on the sides of the control panel enclosure should be removed, cleaned with a damp cloth, dried, and re-inserted. The filters can be accessed by popping out the plastic covers.

OzonePro Fan Filter Maintenance



Above: The two enclosure fan filters are located on either side of the control panels. The air cooling fan outlet is on the O2 Generator enclosure, left, and the inlet is on the O3 Generator on the right.

To access a filter, pop out the plastic cover from the outside.

Figure 16: accessing the fan filters

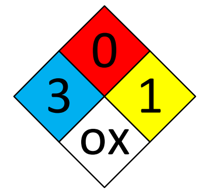
12.3 Barometer Water Level Check (some models)

Appendix A: I/O Cards

Below is a detailed chart of I/O card assignments for the OzonePro System.

Module	Type	Range	Units	Field Device
0	Digital Output	n/a	n/a	Oxygen Generator power contactor 220VAC
				Oxygen Generator power contactor 220VAC
				Water pump relay
				Alarm relay
1	Digital Output	n/a	n/a	Ozone Generator off command relay
				Ozone Generator on command relay
				Ozone safety valve (block valve)
				Spare
2	Analog Input	0-1000	mV	ORP Meter
		configurable	configurable	Spare
		configurable	configurable	Spare
		configurable	configurable	Spare
3	Analog Input	configurable	configurable	Spare
		configurable	configurable	Spare
		configurable	configurable	Spare
		configurable	configurable	Spare
4	Analog Input	0-5	amps	Ozone bus current
		0-500	Vdc	Ozone bus voltage
				Spare
				Spare
5	Digital Input	n/a	n/a	Ozone power on
				Oxygen pressure ok
				Ozone ok
				Spare
6	Digital Input	n/a	n/a	Oxygen power on
				External control selected
				Spare
				Spare
7	Digital Input	n/a	n/a	Ozone Generator flooded cell
				Ozone Generator running
				Ozone Generator fault
				Ozone Generator locked
8	Analog output			Ozone block power control
				Ozone block-DC
9	Digital input	n/a	n/a	Flow meter
				Flow meter

APPENDIX B: OZONE MATERIAL SAFETY DATA SHEET



NFPA 704: Flammability = 0; Health = 3; Reactivity = 1; Special = oxidizer

Section I: Product Information	
Product Name	Ozone (gaseous)
Synonyms	Triatomic Oxygen, O3
Chemical Formula	O3
Description	Occurs in atmosphere from UV light acting on oxygen at high altitude. Commercially derived by air flowing through two electrodes carrying high voltage AC. Also appears as a by-product of welding, high-voltage equipment, or UV radiation.
Caution	O3 is a powerful oxidizer, and is very chemically reactive. Inhalation can create respiratory irritation, pulmonary edema, and affect the eyes, blood, and nervous system.
Intended Use	On-site synthesis for water decontamination.
Section II: Hazards	
Ozone, CAS No. 10028-15-6: NIOSH RTECHS No. RS8225000	
2016 NIOSH REL: C 0.1 ppm (0.2 mg/m^3) OSHA PEL: 0.1 ppm (0.2 mg/m^3) TWA NIOSH IDLH: 5 ppm. ACGIH TLV: Ceiling = 0.1 ppm (0.2 mg/m^3)	
Section III: Physical Data	
Boiling Point	-169°F
Vapor Pressure	>1 ATM
Vapor Density (AIR=1)	1.6
Solubility in Water	0.49 ml @ 32°F (0°C), 3ppm @ 20°C
Melting Point	-315°F (-193°C)
% Volatile by Volume	100%

Molecular Weight	48 g/mol
pH	Unlisted
Critical Temperature	10.22°F (-12.1°C)
Appearance and odor	Colorless to blue gas (> -169°F); characteristic odor often associated with electrical sparks or lightning when < 2ppm, and disagreeable > 1-2 ppm. Olfactory fatigue is rapid, so do not use as a preventative warning device.
Section IV: Fire and Explosion Data	
Flash Point	Nonflammable
Extinguishing Media	Use large amounts of water spray or fog to put out fires involving ozone. Use appropriate fire-fighting techniques to address surrounding material.
Section V: Reactivity Data	
Stability	Ozone is not stable and tends to spontaneously break down into O2. Cannot form polymer chains or three-dimensional networks.
Chemical Compatibility	Ozone is chemically incompatible with all oxidizable materials.
Conditions to Avoid	Ozone will spontaneously decompose to O2 gas, which is an oxidant. Flammable materials in the presence of an oxidant source and ignition will burn readily, with increased fire strength. Avoid presentation of ignition sources such as heat, sparks, or open flame. Avoid strong reducing agents.
Section VI: Health Hazard Data	
Carcinogenicity	Ozone is not listed as a carcinogen.
Primary Entry	Inhalation
Target Organs	Respiratory system, eyes, blood
Summary of Risks	May irritate respiratory tract (experienced as nasal and throat irritation, dryness, chest pain and congestion, breathing problems and coughing. Eye irritation, headache, nausea and drowsiness may occur. Concentrations > 9ppm may result in pneumonia with delayed onset, and high concentrations may be fatal.
Acute Effects	Acute damage from ozone appears to result from oxidation of tissues.
Chronic Effects	Respiratory disease, lung damage
Conditions Aggravated by Long-Term Exposure	Respiratory and heart disorders

First Aid	Remove affected individual from ozone source to fresh air, seek medical assistance immediately. If eyes were exposed, gently flush eyes with water for 15 minutes or until transported to a medical facility; if inhaled, remove person to fresh air, support breathing, get medical help.
Section VII: Precautions for Safe Handling and Use	
Actions to Take in Case of Leak	Discontinue production; isolate and ventilate area; notify personnel; deny entry to area; follow applicable OSHA regulations.
Disposal	Use ventilation to disperse ozone to outer atmosphere. Follow federal, state, and local regulations.
Section VIII: Control Meaures	
Respiratory Protection	If > 10ppm (high level) use MISH/NIOSH approved self-contained breathing apparatus. For low level (0.3-10ppm), canister-type (carbon) respirator may be used.
Eye Protection	Wear chemical safety goggles if working with high ozone
Skin Protection	Minimal or no effects on skin
Ventilation	Provide general and local exhaust ventilation to disperse small amounts of ozone into atmosphere
Section IX: Special Precautions	
Storage Considerations	Prevent ozone from coming into contact with strong acids, bases, or strong oxidizing/reducing agents.
Ventilation	Ventilation should be installed to keep concentrations below ACGIH/OSHA exposure limits; ambient monitors should be present to sense ozone leaks and shut down ozone production in the event of a leak.