Thermo Scientific
Orion Chlorine XP

Water Quality Analyzer

UM-269688-001   •   Revision C • November 2016

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Contents

1

Preface

Intended Use

This manual is for qualified and trained service technicians who will install and service the Thermo Scientific™ Orion™ Chlorine XP™ Water Quality Analyzer. It provides instructions on how to install the Orion Chlorine XP system, how to integrate it with external chemical dosing systems and how to calibrate, operate and maintain the system.

Safety PreCAUTIONs

Warning

Only properly trained and licensed electricians should attempt to wire or service the electronic components of the analyzer.

There is an Electrical Shock Hazard when servicing this system.

Always verify that all electrical power source(s) are off before opening the analyzer unit or attempting to service electronic components or wiring.

CAUTION

Extreme CAUTION should be used when installing, operating and maintaining the Orion Chlorine XP Water Quality Analyzer.

Only properly trained technicians are authorized to install and maintain the analyzer.

Only properly trained and licensed electricians should attempt any change to the system's electrical components.

Always follow local health and safety regulations when performing any service on the Chlorine XP analyzer.

2

Overview

The Orion Chlorine XP Water Quality Analyzer continuously monitors chemical levels in a process water application. The Chlorine XP analyzer automates free chlorine, total chlorine, pH and flow rate, administering chemicals as required.

The Orion Chlorine XP Analyzer Platform

Various methods have been developed over the years to monitor the concentration and balance of biocide chemicals used in water disinfection. In a typical application, the Chlorine XP analyzer measures free or total (and optionally both free and total) chlorine levels with a DPD-based colorimetric system. The method utilizes a DPD reagent chemistry which is an accepted method by many regulatory agencies such as US EPA and China EPM. The colorimetric analyzer is completely objective and not dependent on lighting conditions or the operator's eyesight, resulting in more repeatable and accurate measurements. The product design minimizes calibration frequency and is compatible with all types of active biocide disinfectants such as chlorine, chloramines, chlorine dioxide, bromine, and ozone. The product design automatically and accurately measures free chlorine using the smallest amounts of reagent for the longest maintenance cycles.

Once installed and calibrated, the Chlorine XP analyzer is a fully automatic analyzer. The platform is expandable with optional pH, temperature, and ORP measurement parameters. Additionally, add-on features for conductivity and turbidity are also available. (Please call customer service for details). The Chlorine XP is simple to use with its clear-cut display panel

and parameters menu. The built-in software allows for automated operation, making reliable measurements a routine. All basic information can be viewed at a glance, and changing settings is as simple as scrolling through the menu and adjusting the current settings.

Measurements and Features

The Chlorine XP analyzer comes standard with chlorine measurement and can be configured to measure any combination of the following water quality parameters:

- Free Chlorine
- Total Chlorine
- Both Free Chlorine and Total Chlorine

Optional Measurements:

- Temperature
- pH

Optional communication protocol:

- Modbus®

Several communication options are also available:

- 2 Standard 4 to 20 mA Outputs (up to 4 channels)
- 4 optional 4 to 20 mA Outputs (up to 6 channels + dry contact alarms)

System Components

The Chlorine XP has two primary units: the analyzing unit and the control unit. The analyzing unit performs the actual measurements. It contains the following components:

Colorimetric Cell – measures free or total (and optionally both free and total) chlorine levels in the water using DPD reagents and a closed-cell, digital photometer.

Acrylic Flow Cell – Contains the sensors, including the pH and temperature sensors.

Reagent Bottles – Contains the reagents used by the colorimeter to measure chlorine levels in the water. Each bottle is equipped with non-return valves to prevent water flowing back into the bottles.

Reagent Pumps and Solenoid Valve – Accurately controls the flow of water and reagents into the colorimeter, making every measurement as accurate as possible.

The control units include all electronics, the user interface and the software that controls the measurements performed in the analyzing unit. It includes the following components:

I/O Module (Input/output) – Power supply to the analyzer; contains the dry-contact relays for direct control of external components.

Control Panel Module – Calculates the measurement results. The Control Panel Module also provides data to external communication devices such as the 4-20mA outputs or the wireless communication package.

Keyboard Panel – Mounted on the cover of the control module, it functions as the Chlorine XP's user interface. The control panel displays current measurements and indicates alarms. All settings and adjustments are accessible through the control panel.

pH, Temp Module* – Receives the signal from the pH, Redox, and temperature probes.

Internal 4-20 Input Module* – Contains connections for the turbidity and conductivity meter and the 4-20 flow meter.

Internal 4-20 Output Module* – Provides up to four 4-20mA outputs for any measured variable.

Water intake filter – Provides optimal water filtering and easier cleaning.

Sensor cables – Routed behind the solenoids and are securely fastened using a special loop.

*Optional Module

Figure 1: Chlorine XP Analyzer Main Components
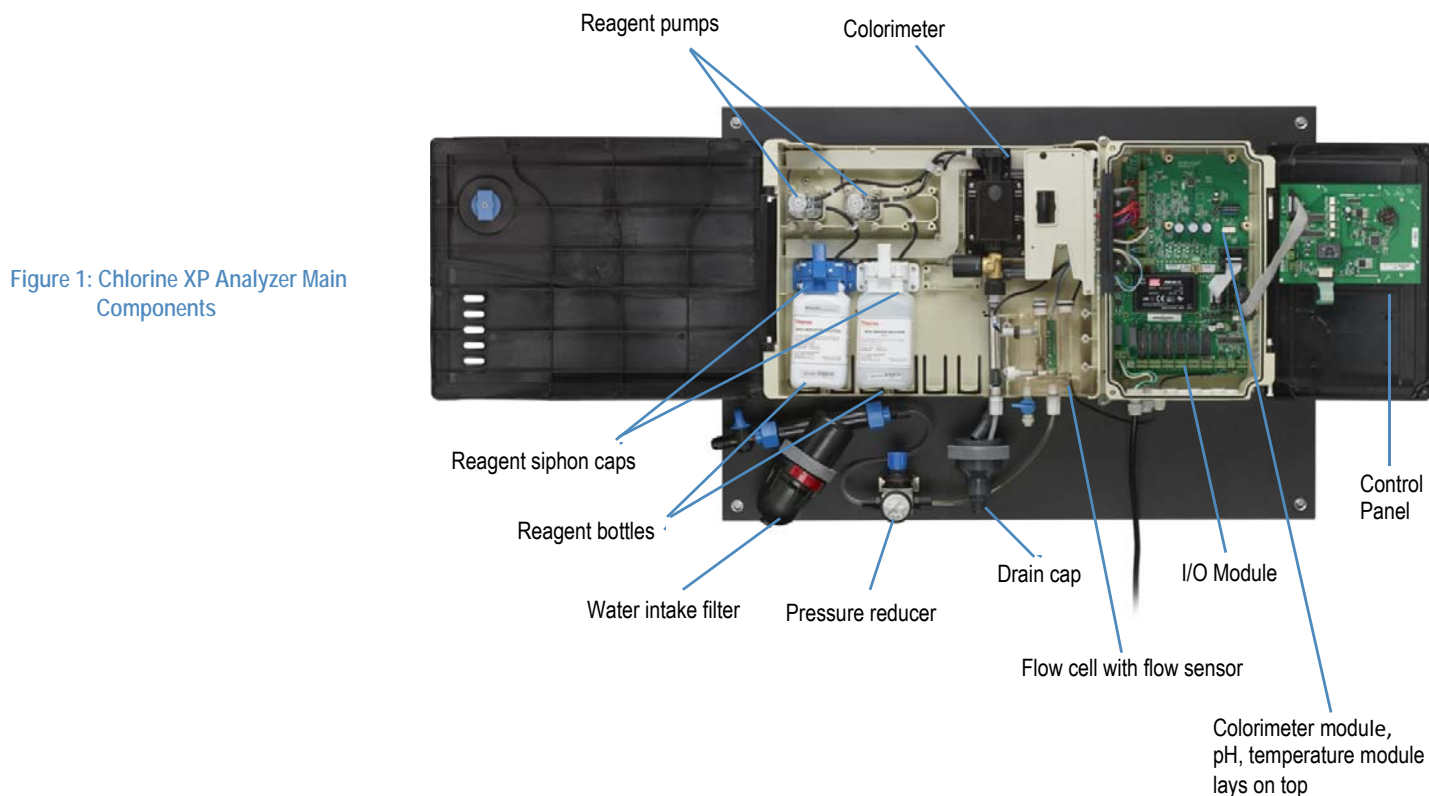
3

SECTION 3   ## Installation

Location Considerations

Take extra time in selecting a location since the installation location will determine the ease of the installation and future operation and maintenance. The location where the Chlorine XP is installed is dependent on various considerations:

Convenient Access – The Chlorine XP analyzer should be installed where it can easily be viewed and operated.

Dry Area – The Chlorine XP analyzer requires a clean, dry area for safe operation, reagent installation, and electrical connections.

Minimum Distance from Supply Pipe – The water sampling line that is connected to the main pipe that feeds the Chlorine XP analyzer should be as short as possible. A long sample creates an unnecessary delay between supply and measurement. We recommend the sample line has a flow velocity of 10 ft./sec. to prevent settlement of dissolved and suspended materials.

Drainage – The installation location requires the sample water outlet of the colorimeter to gravity drain without creating an obstacle (i.e. no pipe across walkway). The flow cell may be pressurized up to 14.5 psi (1 bar) to allow for return to the water pipe.

Freezing Temperatures – The analyzer should be installed in a location that is not susceptible to freezing temperatures. The sample water and reagents may freeze, preventing accurate readings (even when thawed). Additionally, components may be damaged due to expansion when ice forms.

Site Requirements and Installation

The Chlorine XP assembly is wall mounted. The complete unit with all connections weighs 18 lbs. (8 kg), so it must be mounted securely onto a stable wall. The Chlorine XP unit measures 26.3" x 13.1" (66.8 cm x 33.2 cm). The base of the complete Chlorine XP assembly should be mounted at least 24" (60 cm) above the floor (preferably at eye level).

The Chlorine XP unit and its mounting panel are not shipped with mounting screws or anchors. The installer must provide screws and anchors that can hold the weight of the unit, mounting panel, intake filter and electrical outlets and junction boxes. The screws and anchors must be compatible with the wall where it will be installed.

Mechanical Installation

Figure 2 illustrates steps 3 to 5 in the following procedure:

1. The Chlorine XP is shipped pre-mounted on a mounting panel, along with a water filter. The mounting panel includes four screw holes, compatible with 5/16" (8 mm) screws, one in each corner.
2. Determine the location of one hole on the Chlorine XP unit or on the mounting panel.
3. Secure one corner of the Chlorine XP unit or mounting panel to the wall.
4. Level the Chlorine XP unit or mounting panel and mark the remaining three (3) screw holes.
5. Secure the remaining corners to the wall using 5/16" (8 mm) screws.

Figure 2: Chlorine XP Mounting Panel
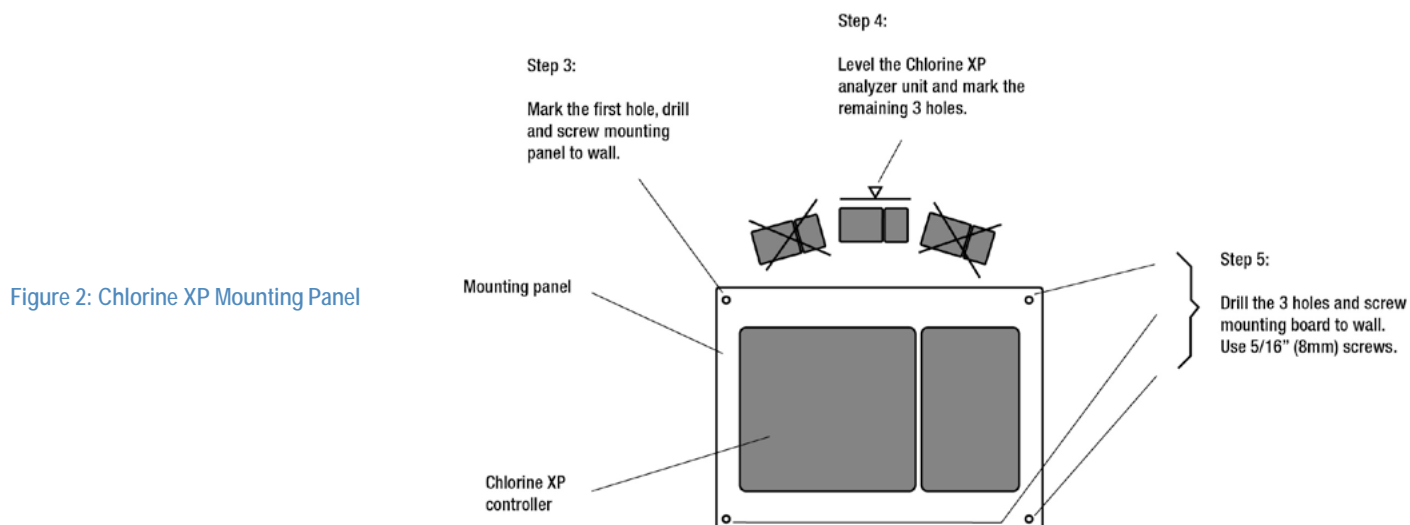
Plumbing Requirements and Installation

Water Supply

The Chlorine XP requires a pressurized water supply to the flow cell. An isolating valve must be installed between the main line and the pipe (or tube) to the analyzer. The minimum inlet pressure should be 4.4 psi (0.3 bar) and should not exceed 14.5 psi (1 bar) using a pressure reducing valve attached to the outlet of the pre-filter. Install the provided pressure reducing valve on the mounting panel using the provided holder and note the direction of the holder.

The distance from the main pipe to the analyzer should be as short as possible, in order to minimize the delay time between the water being sampled and the Chlorine XP measurement.

Drainage

A pressurized, vacuum, or gravity connection is required from the outlet of the flow cell to return water from the flow cell to the water supply. A ¼" FNPT fitting is supplied for the flow cell drain connection.

A gravity drainage connection is required for the water coming out from the colorimeter. The length of the colorimeter drain line should be as short as possible and must have a constant downward slope to prevent a backflow of water. A drain cap is located on the colorimeter outlet to prevent the backup of water into the colorimeter if the drain line is blocked. A ½" MNPT fitting is supplied for the colorimeter drain connection.

Figure 3: Flow cell and Colorimeter Inlet and Outlet

Flow cell outlet

Colorimeter outlet

Sample flow cell with flow sensor

Water inlet

Sample valve
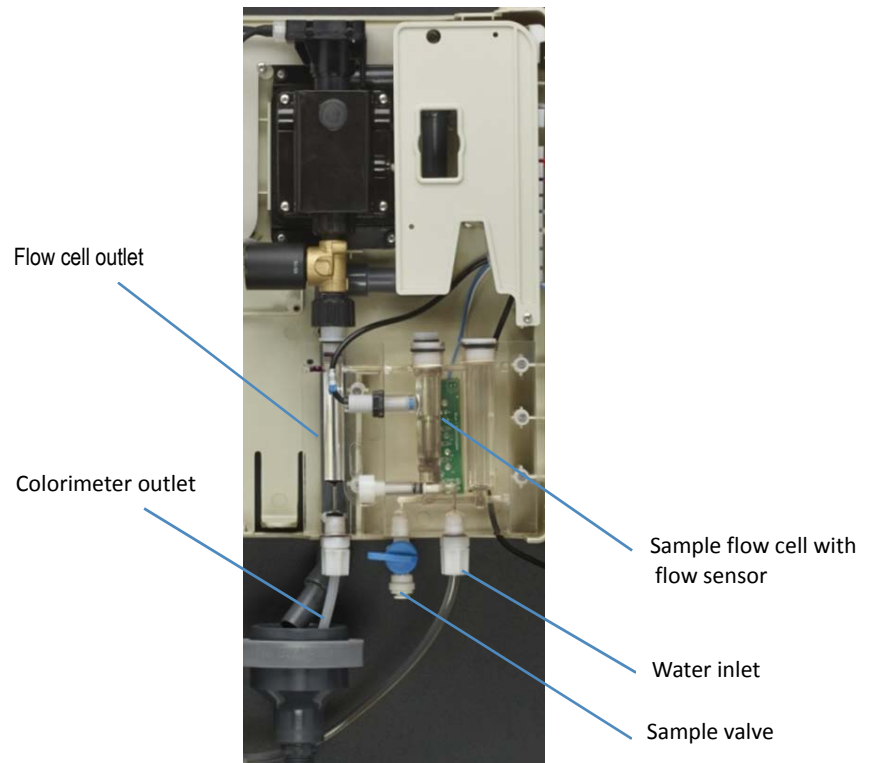
Note: The Chlorine XP colorimeter drains water at zero (0) pressure. The drainage pipe should be as straight as possible and have a constant downward slope and should not have any bends where water flow can be restricted. If the colorimeter drains to a bucket or basin, the end of the drainage pipe should terminate above the bucket or basin rim.

Electrical Requirements and Installation

The Chlorine XP analyzer requires a 100-115 or 200-230 VAC, 50/60 Hz electrical power source on a separate 16A circuit in the plant room's electrical board. The main Chlorine XP power supply should be connected to a non-dependent power supply, so that the unit remains powered constantly. The active relays should be connected to a dependent power supply (interlocked power supply).

Connecting the Main Electrical Power

Verify that the power switch or circuit breaker to the non-dependent power source is OFF.

1. Connect the line (live) wire to the I/O board connector marked Line.

2. Connect the neutral wire to the I/O board connector marked Neutral.

3. Connect the earth wire to the I/O Module connector marked Ground.

4. Continue with the other electrical connections.

5. Turn on electrical power only after all electrical connections have been completed.

Input Switches

Flow input switch terminal blocks on the I/O module allow for three input switches to be connected to the system as additional layers of security against accidental chemical additions when there is no flow. If a connection is expected but not detected at each input, the analyzer/controller will indicate an alarm and will close all relays (and open the alarm relay). Therefore, if a safety switch (flow, level, etc.) will not be installed, a fixed connection (jumper wire) is required to allow the controller to operate.

Two flow switches and one flow meter may be connected:

- Proximity flow switch (internal): Flow switch connected to the flow cell of analyzer. Connect the Black wire to "IN", Blue wire to "GND", and Brown wire to "VCC".
- External flow switch: Connection for an external 2-wire flow switch. If an external switch is not connected, a jumper must be installed for the analyzer to operate properly.
- Flow Meter: Connection for 2 or 3-wire flow meter. The analyzer will not look for the flow meter connection unless the option is turned ON in the technician menu; therefore, no jumper is required if a meter is not installed.

CAUTION: Electrical connections depicted in this section are ONLY recommendations. All electrical connections should comply with National Electrical Code (NEC) and all local regulations.

4

First Time Operation and Calibration

Installing Additional Sensors and Meters

Install all additional sensors and meters and connect to the Chlorine XP's main system, following the supplemental manuals for each sensor or meter.

Installing Reagents

For Free Chlorine Only measurements, DPD1 reagent set will be used.

For Total Chlorine Only measurements, DPD4 reagent set will be used.

For both Free and Total Cl measurements, DPD1 and DPD3 reagent sets will be used.

The reagents should be installed according to the labels located behind the reagent holder. Please refer to the following installation:

For Free Cl Only:

1. Free Chlorine Indicator (DPD1)
2. Free Chlorine Buffer (DPD1)

For Total Cl Only:

1. Total Chlorine Indicator (DPD4)
2. Total Chlorine Buffer (DPD4)

For Free Cl + Total Cl:

1. Free Chlorine Solution (DPD1)
2. Free Chlorine Buffer (DPD1)
3. Total Chlorine Solution (DPD3)

Figure 4: Flow cell and Colorimeter Inlet and Outlet

1. Open the Chlorine XP Chlorine Indicator and Buffer kit. The following items should be in the box:

   a. Chlorine indicator and buffer mixing instructions.

   b. 1 X 600 ml bottle of chlorine buffer with a white label.

   c. 1 X 600 ml bottle of chlorine indicator fluid with a blue label.

   d. 1 X small bottle of chlorine indicator salt with a white label.

2. Remove the caps on both the indicator fluid (c) and small indicator salt (d) bottles.

3. Empty the entire contents of the indicator salt (d) into the bottle of indicator fluid (c).

4. Place the cap on the bottle of chlorine indicator fluid (c) and close tightly.

5. Turn the bottle upside-down slowly and carefully, so that no bubbles form in the fluid.

6. Repeat five (5) times until all the indicator salt is dissolved in the indicator fluid.
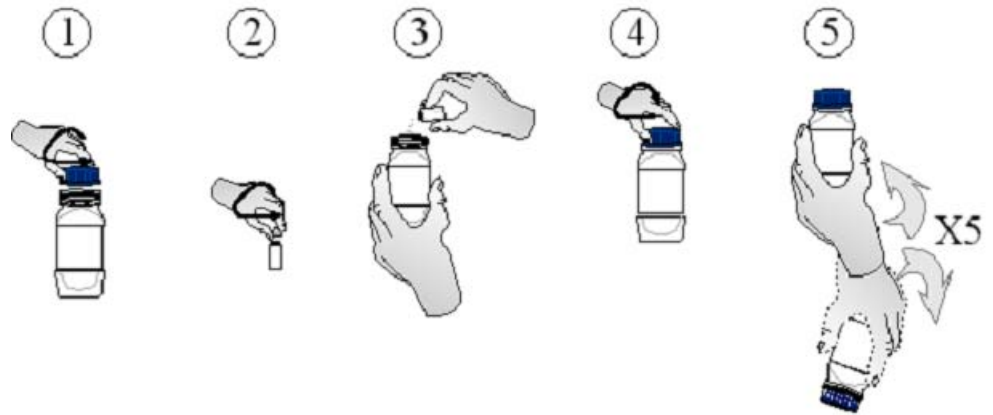
7. Place the reagent bottles in position:

  a. Remove the cap from the reagent bottles.

  b. Place the opening of the reagent bottle below the bottle siphons.

  c. Lift the bottle up until the opening reaches the bottle siphon cap.

  d. Push the lever above the siphon cover away from you, and push the reagent bottle up.

  e. Push the bottom of the bottle into position.

CAUTION: Do not refill the reagent bottles. Do not mix or add reagent from other bottles. Do not use any non-Thermo Scientific reagents.

8. Prime the reagent pumps:

  a. Press Menu on the control panel keypad until the Reagent Pump menu appears.

  b. Press OK.

  c. Enter password (123 is default) using the up or down arrows.

  d. Press OK (OFF will appear on top line).

  e. Press OK again (OFF will appear on the top and bottom lines).

  f. Press UP to turn the reagent pumps ON.
      Note that the pumps will not prime until the analyzer has initialized.

  g. Press OK when the water flowing from the colorimeter has a red tint or reagent drops are being formed at the needle tips.

  h. Press Escape twice (2x) to return to the main screen

Note: If outside of the range of 0.2 to 10 ppm, remove the colorimeter cap and confirm that reagents are being pumped.

First Time Menu Setup

This section describes how to configure the settings (set points, alarms, password and calibrations) through the Chlorine XP's control panel.

CAUTION: The Chlorine XP's control board unit should not be opened except for initial installation and troubleshooting and should only be opened by a trained and approved technician.

Chlorine XP Control Panel

The Chlorine XP control panel is a simple, intuitive interface for monitoring and controlling water quality with the following components:
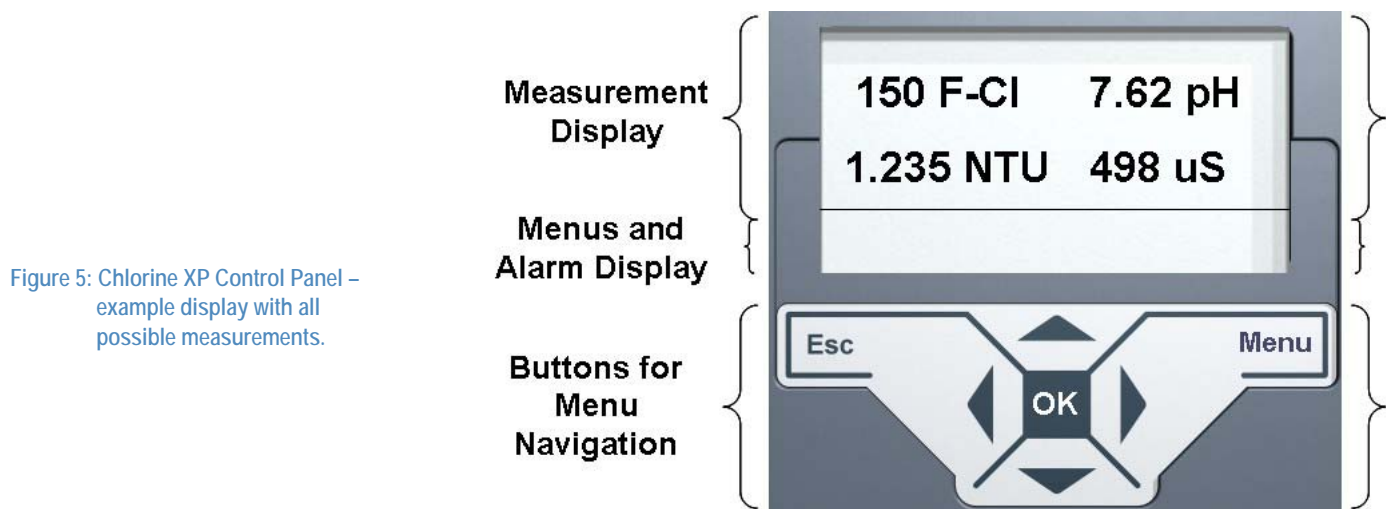
Figure 5: Chlorine XP Control Panel – example display with all possible measurements.

Control Panel Structure	
Measurement Display	At the top of the control panel is an LCD display which shows all measured variables at top and all Alarms and Menus at bottom.
Menu Button	Enters and scrolls through the menus.
Esc	Moves one level back in the menu without making changes.
OK	Enters setting change mode and accepts setting change.
Up/Down Arrows	Changes value up or down.

When an alarm is issued, the bottom row of the LCD displays the alarm. Pressing the up and down arrows together will display the Langelier index for approximately five (5) seconds, and then returns to the previous display mode.

Setting Up the Operator Password

Use the following procedure to set up the password for Operator. The default password is "123." You may change the password but be sure to save it in a secure place. If necessary you can restore the password easily.
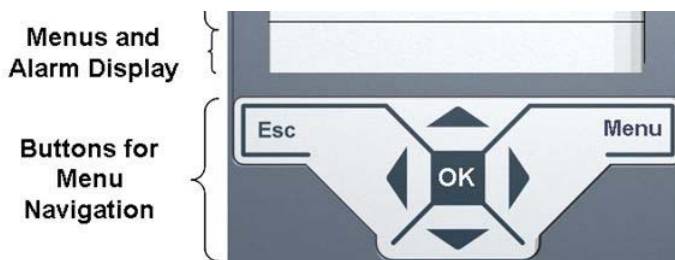
1. Press **Menu**. At the same time use the arrow keys to select the number "82" in the Menus and Alarm Display section of the Chlorine XP Control Panel.

2. To change the password:

    a. Enter the previous password.

    b. Enter the new password.

    c. Confirm the new password.

Operator Menu

The Chlorine XP has two menu levels: operator and technician. The operator menu includes settings that may be controlled by on-site operators. The technician menu includes settings and calibrations that should be restricted to specially trained Chlorine XP maintenance technicians. Each menu has a separate password. The technician level password may be used whenever a password is required, however the operator password will only be accepted in the operator menu.

Operator Menu Functions and Descriptions	
Function Name	Description
Menu Relays	Manual activation of relays
Reagent Pump	Manual activation of reagent pumps
Cl Set Point1	Controls Cl relay 1 – on/off or proportional
Cl Set Point2	Controls Cl relay 2 – on/off only
F-Cl Calibrated to Sensor Value Was	The value to which the F-CL was recently calibrated Value of the recent sensor measurement
Cl Low Alarm	Initiates an alarm when Cl is below value
Cl High Alarm	Initiates an alarm when Cl is above value
Cl Interval	Time between Cl measurements
pH Set Point*	Controls pH relay 3 – on/off or proportional

Operator Menu Functions and Descriptions	
Function Name	**Description**
pH 7 Calibrated to* Sensor Value Was	Most recent calibration & sensor value at calibration for troubleshooting purposes
pH 4,10 Calibrated to* Sensor Value Was	Most recent calibration & sensor value at calibration for troubleshooting purposes
pH Low Alarm *	Initiates an alarm when pH is below value
pH High Alarm*	Initiates an alarm when pH is above value
Temp Calibrated to* Sensor Value Was	Most recent calibration & sensor value at calibration for troubleshooting purpose
Temp Low Alarm *	Initiates an alarm when temp is below value
Temp High Alarm*	Initiates an alarm when temp is above value
Alarm Delay	Time delay before alarm relay 5 closes
Flow Low Limit*	Low limit for external flow meter
Flow k-factor*	k-factor for external flow meter
T-Cl Calibrated to* Sensor Value Was	Most recent calibration & sensor value at calibration for troubleshooting purposes
Total Cl High Alarm*	Initiates an alarm when total Cl is above value
Comb. Cl High Alarm*	Initiates an alarm when combined (free & total) Cl is above value
Language	Choice of language
System Reset	Restarts the controller – a safer option than turning it off and on

* Optional features

Operator's Menu & Variables Limits				
Function Name	**Min Value**	**Max Value**	**Default**	**Units**
Menu Relays	Off	On	Off	--
Reagent Pump	Off	On	Off	--
Cl Set Point1	0	9.99	1.5	ppm
Cl Set Point2	0	9.99	1.5	ppm
F-Cl Calibrated to Sensor Value Was	0.1	9.99	n/a	ppm
Cl Low Alarm	0	9.99	0.5	ppm
Cl High Alarm	0	10	2.0	ppm
Cl Interval	2:00	10:00	2:00	min
pH Set Point*	4.0	14.0	7.40	--
pH 7 Calibrated to* Sensor Value Was	4.0	14.0	n/a	--
pH Low Alarm *	4.0	14.0	6.90	--
pH High Alarm*	7.0	13.9	7.80	--
pH 4,10 Calibrated to* Sensor Value Was	4.0	10.0	7.40	--
Temp Calibrated to* Sensor Value Was	1/34	49.9 /121.9	n/a	°C / °F
Temp Low Alarm *	1/34	49.9 /121.9	18°C	°C /°F

Operator's Menu & Variables Limits				
Function Name	Min Value	Max Value	Default	Units
Temp High Alarm*	1/34	49.9 /121.9	50ºC	ºC / ºF
Alarm Delay	0	10	0:30	min
Flow Low Limit*	0	200 or 999	0 = off	M3/hr or GPM
Flow k-factor*	0.001	655	0.01	--
T-CI Calibrated to* Sensor Value Was	0.01	9.99	1.50	ppm
Total CI High Alarm*	0	9.99	3.5	ppm
Comb. CI High Alarm*	0	9.99	2.5	ppm
Language	--	--	English	--
System Reset	n/a	n/a	n/a	--

* Optional features

Note: In a FOT (Free or Total) model, choosing T-CL in the menu will result in the disappearance of the F_CL from the screen and vice versa.

Configuration Settings in the Operator Menu

Each of the parameters in the operator menu is configured in the same way. The following procedure describes how to configure a typical setting:

1. Locate the desired parameter in the menu:

    a. Press Menu until the desired parameter name appears in the LCD display.

2. Press OK. "Enter Password 100" appears in the LCD display.

3. Enter the operator password (or technician password; both are accepted).

4. Press the up arrow or down arrow until the password number is reached.

    Note: Holding Menu while pressing up or down will advance the first digit. Holding up or down for an extended period of time will proceed through the numbers more quickly. The factory-set operator password is 123. The operator password can only be changed by entering the current operator or technician password (see Technician Menu Setup).

5. Press OK to accept the password. The parameter's name and current setting appear in the LCD display.

6. Press OK, again. The LCD display shows the parameter and the current setting.

7. Enter the new parameter setting:

    a. Press the up arrow or down arrow until the desired value is reached.

    b. The second row of the menu display, below the value that is being changed, shows the current value.

8.　Press Enter to save the new setting or Esc to abort without saving the new setting. To change the settings of additional parameters, press Menu until the desired parameter appears in the LCD display. Repeat steps 6-8 above to set the new parameter.

Note: The Menu button displays the next parameter in the list, so that the operator can check every parameter in the menu. There is no scroll-back option. To view or change a previous parameter in the menu, you must exit the menu by pressing Esc, and start the above procedure from the beginning.

Calibration

Parameters must be calibrated with measurements taken with external testing devices. Always use digital calibration devices, not the less accurate visual test kits. Alternatively, standard solutions may be used. Make sure the standard solution is not expired or contaminated prior to using. Follow the procedures below EXACTLY as instructed.

ALWAYS take water for calibration from the sampling valve, NOT from the process line directly. The analyzer should always be calibrated with water from the same source.

Note: Chlorine calibration is only required every 6 to 12 months in most cases. Minor deviations will exist between all testing equipment. These minor differences do not warrant the calibration of the colorimeter.

Note: Chlorine calibration should always be performed at the fifth measurement cycle, in order to enable stabilization of the conditions.

Chlorine Calibration for the numbered list

1.　Open the water sampling valve. Let water flow while observing the colorimeter countdown timer in the LCD display.

2.　Fill the sampling container when the countdown timer reaches zero (0).

3.　Test the water sample for chlorine using a digital photometer.

4.　Press Menu until "Cl Calibrated to" appears in the LCD display.

The top line will display "Cl Calibrated to" and a number. The number displayed is the last value entered for the calibration.
The bottom line will display "Cl Sensor was" and a number. This number is the sensor reading without any calibration at the time of the last calibration.
If there is a large discrepancy between the above two numbers - the sensor was calibrated improperly or there is a problem with the analyzer.
The analyzer uses the calibrated value, as shown on the main screen, to determine dosing rates.

Note: Chlorine calibration should always be performed within 25% of the set point. If current chlorine level is 25% above or below the set point, do not perform calibration until the chlorine level is closer to the set point.

5. Press OK.

6. Enter the password. Press the up arrow or down arrow until the password is reached.

7. Press OK.

8. Press OK again.

   The display will now show "Calibrate Cl to" on the top line and "Sensor Reading" on the bottom line.
   The "Sensor Reading" is the current reading of the sensor with no calibration.
   The "Calibrate Cl to" value is the new value which you want to set.

9. Press the up arrow or down arrow until the value is the same as the value given by the digital photometer.

   Note: The Chlorine XP will not allow calibration above +/- 0.5 ppm from the un-calibrated sensor reading. If the value given by the digital photometer is more than +/- 0.5 ppm from the currently calibrated value, retest the water in the digital photometer. If the value is still more than 0.5ppm above or below the calibrated value, try testing the water with another device. If there is still a deviation of more than 0.5ppm between the new digital photometer, there may be a problem with the Chlorine XP colorimeter, which cannot be corrected by calibration alone.

10. Press OK to save the new calibration or Esc to abort without saving.

11. Press Esc to return to the main display.

Calibrating other Sensors and Meters

Calibration of other sensors and meters is similar to the chlorine calibration and requires the use of a reliable external testing device or standard solution. See the supplemental manuals for each sensor or meter for specific information on calibration.

Calibration and Initial Operation Checklist

Before leaving the site, perform the procedure in this section and record the requested values. Calibrate the following Chlorine XP parameters and enter the information into the table below. If the pH is reading slightly low, do not calibrate as they will continue to increase for the first 24- 48 hours.

Calibration Table		
Date	Site	Technician's Name
Parameter	Analyzer Reading	External Device or Standard Value
Free Cl		
Total Cl		
pH		
Temperature		
Flow Rate		

5

SECTION 5 Routine Operation and Maintenance

Once installed by a qualified technician, the Chlorine XP analyzer can begin monitoring and controlling water quality. The analyzer is specifically designed for easy operation; however some periodic maintenance is still required. Basic guidelines are provided in the table below; however the actual schedule may vary depending on conditions and use.

Control Panel Structure	
Service Required	Expected Frequency
Replacing Reagents	1 to 2 months
Cleaning Pre-filter	1 month (clean when visible dirt/oil)
Cl Calibration	6 months
Other Sensor Calibration	1 to 3 months
Replacing Reagent Pump Head and Tubes	12 months

- **Basic Operation**: Involves setting the desired parameters and monitoring the system for alarms. When operating normally, the Chlorine XP requires low maintenance.

- **Calibration**: Sensor sensitivity and accuracy can degrade or drift over time. For this reason, the Chlorine XP settings must be periodically recalibrated and compared with measurements from other measuring devices, such as electronic photometers, pH sensors, and thermometers, or compared to standard solutions like pH buffers.

- **Reagent Replacement:** The Chlorine XP analyzer uses a very small amount (approximately 0.03 ml) of chlorine reagents each time water is sampled. The two 600 ml bottles last approximately 4 to 8 weeks depending on the measurement interval selected. A Low Reagents alarm is issued when either one of the reagent bottles approaches depletion and should be replaced. If the reagents are not replaced before the reagents are depleted, the testing will stop and a No Reagents alarm will be displayed. Therefore it is important to replace reagents before this occurs.

- **Filter Cleaning:** The Chlorine XP unit has a filter installed in its water supply pipe, which collects particles and impurities. It should be cleaned or replaced periodically, depending on water quality. The clear filter cover allows a quick visual inspection to determine if cleaning is required.

- **Shut-down and Winterizing:** If the analyzer will not be operating for an extended period of time or in areas where temperatures drop below freezing, all water must be removed from the analyzer to prevent components from breaking. The probes must be removed and stored in a warm area and kept wet at all times.

- **Start-up and Preventive Maintenance:** A preventative inspection and cleaning of components should be completed whenever the analyzer is restarted after a long (> 2 weeks) downtime or at least annually if the analyzer is operating constantly. Likewise, the analyzer has several mechanical components that will wear out over time. To prevent future problems, these components should be checked and/or replaced periodically.

- **Troubleshooting:** Occasionally problems may occur with the analyzer readings or chemical dosing. These problems are most often simple to correct. The troubleshooting section provides an outline to follow to help correct the problems easily.

Monitoring the Chlorine XP Alarms

The Chlorine XP analyzer issues alarms when it detects chemical levels that are above or below the allowed range. Every alarm is automatically displayed in the LCD status display and logged in the data logger. Most deviations in chemical levels, however, are automatically corrected. Thus, the internal alarms do not immediately activate an external alarm. A delay mechanism prevents false alarms from minor deviations that were automatically corrected. The external alarm is only activated after an internal alarm has been continuously active for a certain period of time, as defined by the operator.

The Alarm Delay command in the Operator menu sets the number of seconds the Chlorine XP waits before closing Relay 5, the relay that operates the external alarm. Only one alarm is shown on the screen at a time based on importance and the order in which it should be fixed. For example, if pH is high and ORP is low, only the pH alarm will be indicated since lowering the pH will likely also correct the low ORP. All of the alarms are presented in the following table along with a description and resulting action of the analyzer/controller.

Alarm Description and Result			
Alarm#	Alarm	Description	Result
A1	No flow	There is not enough water reaching the controller.	Stop all chemical dosing (all relays are open).
A2	Low flow	The water flow rate in the main circulation pipe is lower than the flow limit.	Stop all chemical dosing (all relays are open).
A3	Check CLRMTR connect	Communication error between colorimeter and colorimeter board.	No chlorine dosing – optional ORP emergency mode
A4	No reagents	Reagents are empty.	No chlorine dosing – optional ORP emergency mode
A5	Stuck piston	The piston is not moving properly.	No chlorine dosing – optional ORP emergency mode
A6	Unclean cell	The glass in the colorimeter is dirty.	No chlorine dosing – optional ORP emergency mode
A7	Replace light	LED in colorimeter is not working.	No chlorine dosing – optional ORP emergency mode
A8	Low reagents	Reagents are below 20%.	Blue LED will flash – message only
A9	Chlorine < 0.1	Chlorine unusually low.	No chlorine dosing
A11	Low chlorine	Cl below lower limit.	--
A12	High chlorine	Cl above upper limit.	--
A13	Low pH	pH below lower limit	--
A14	High pH	pH above upper limit.	--
A17	EXTERNAL OFF	External flow switch is off.	No chemical dosing
A18	Total Cl high	Total Cl above upper limit.	--
A19	Combine Cl high	Combined Cl above upper limit.	--
A20	Replace DPD3	DPD3 low	Total Cl testing stops
A21	Temp. low alarm	Temperature below lower limit.	--
A22	Temp. high alarm	Temperature above upper limit.	--
A23	Cl overfeed time	Cl dosing on for longer than max time.	Cl dosing stops until reset
A24	pH overfeed time	pH dosing for longer than max time.	pH dosing stops until reset
	No emergency	No problem to allow ORP emergency mode.	-
* No dosing only affects the relay operation. Alarm relay will close and all other relays will open.			

Replacing Reagents

The Chlorine XP analyzer issues a LOW REAGENTS message when the float at the end of one of the reagent siphons detects that one or both of the reagents is approaching depletion. After this time, the analyzer will count down (internally) until the reagents are expected to be completely depleted and the Cl analysis will stop and the analyzer will activate an alarm. The blue LED lights in the flow cell will flash continuously until the reagents are replaced or they are depleted, resulting in a NO REAGENTS alarm and an opening of the chlorine relays, preventing any additional chlorine from being added. Prior to receiving the NO REAGENTS alarm, replace the reagents as described in Section 4.2.

Note: Once mixed (salt into the solution) the reagents have a shelf-life of 2 months, and will lose accuracy if used beyond this time limit.

Cleaning the Filter

The Chlorine XP unit is shipped on a mounting panel. Several other components are mounted on the panel, underneath the analyzer including a water filter, which filters out sand, rust, course debris, oil, and other impurities in the sampled water. These impurities may clog the Chlorine XP's internal pipes, contaminate the sensors, or dirty the analyzing cell, reducing its accuracy.

This filter must be cleaned regularly as it becomes clogged with debris and impurities. The frequency at which the filter requires cleaning depends entirely on how much debris is in the water. The following procedure describes how to remove, clean, inspect, and if necessary, replace the analyzer's water filter:

1. Locate the water filter, mounted below the Chlorine XP unit, and the valve that is located on the water supply pipe.
2. Turn off water supply to the filter and open the filter cup.
3. Remove any loose debris with your fingers.
4. Wash the filter under running water by separating the discs and washing between them.
5. Inspect the filter and replace if any part of the disc filter is broken.
6. Return the filter into place making sure the gaskets, spring and O-ring are in place.
7. Open the water supply valve.
8. Confirm that the water is flowing and the filter is properly sealed.

Shut-Down and Winterizing

The Chlorine XP analyzer is designed to keep the probes submerged even if there is no flow to the analyzer. However, if the analyzer is going to be offline for an extended period of time and/or exposed to freezing temperatures, it must be winterized to prevent damage to the analyzer and the probes.

Note: Before powering off the unit, please make sure that the analyzer's timer is set to 20 sec, enabling the analyzer to finalize the cleaning process.

The timer option can be viewed by pressing the up arrow from the control panel.

1. Store all probes by following directions in the supplemental manuals for each sensor.

2. Drain the flow cell completely by opening the sampling valve on the bottom. Leave the valve in the open position to allow air to completely dry the cell.

3. Remove the reagent bottles and flush each pump tube by inserting the pump tube in a container of fresh water and turning the reagent pumps ON for at least 90 seconds.

4. Remove the pump tubes from the water containers and turn the pumps ON for an additional 90 seconds to remove any water.

5. With the solenoid valve in the open position, turn off the power to the analyzer. If the solenoid is in the closed position, the unions at the top and bottom of the solenoid should be loosened to allow the colorimeter and solenoid to completely drain.

6. Check the security of the analyzer doors to ensure a weatherproof seal.

Start-up and Preventative Maintenance

After the analyzer (or flow) has been off for a long period of time (> 2 weeks), a few simple checks should be done during the initial start-up. Several components may need to be cleaned and some mechanical parts may be replaced as preventative maintenance.

1. Remove the colorimeter cap and clean the quarts glass using a Kim Wipes[®].

2. Remove the solenoid and check the tip for corrosion (this may occur if shut down improperly) and check the stop for deterioration or signs of wear. The corrosion can usually be cleaned away and the solenoid will continue to work properly. After start-up, confirm that the water is completely stopped when the solenoid shuts. If it is not shutting properly, it must be cleaned or replaced.

3. Inspect the pump tubes for cracks or signs of significant wear and replace if necessary.

4. Install new reagents and prime the tubes.

5. Inspect the needles (in the colorimeter cap) to ensure that droplets are forming and falling properly. Replace if necessary.

6. Replace all additional sensors and meters, close the sampling valve and turn on flow immediately to re-wet any probes.

7. Recalibrate the analyzer.

Note: pH probes will likely require 24-48 hours to re-stabilize and will require re-calibration at that time.

Replacing Reagent Pump Head and Tubes

If the reagent pump head and/or tubes are cracked, appear significantly worn, or are no longer functioning properly, they should be replaced to ensure consistent operation and control.

1. Turn off the power to the Chlorine XP analyzer.

2. Remove the tubes from the pump head and the needles in the colorimeter cap by holding the top of each needle and pulling the tube gently.

3. Remove the tubes from the reagent bottles and wipe off any excess reagent (the DPD will stain, so be careful).

4. Unscrew the two (2) screws on the face of the pump head. Save the screws.

5. Remove the pump head by pulling gently and sliding the pump head off of the motor assembly.

6. Slide the new pump head onto the motor assembly ensuring that the slot in the pump head matches the notch in the motor shaft. DO NOT force the pump head onto the motor assembly; it should easily slide into place.

7. Rotate the pump head and slide the alignment pins into the motor assembly.

8. Replace the two (2) screws to reattach the pump head.

9. Attach the new pump tubes by pressing the tubes onto the connectors on the end of the pump head.

10. Insert the pump tube leading to the bottom of the pump head into the appropriate reagent bottle.

11. Attach the pump tube from the top of the pump head to the needle on the colorimeter cap by holding the needle and gently pressing the tube onto the connector.

Troubleshooting

The following procedures instruct how to locate, evaluate, and fix a problem when the analyzer issues an alarm or indicates suspect chemical levels. For more information, contact Technical Service.

Troubleshooting Table				
Alarm	#	Description	Symptom	Result
No flow	A1	There is not enough water reaching the controller. Stop all chemical dosing (all relays are open).	No chlorine measurements. No dosing.	Increase flow and check flow switch wire connection on board. Check that the switch is not stuck.
Low flow	A2	The water flow rate in the main circulation pipe is lower than the flow limit. Stop all chemical dosing (all relays are open).	No dosing.	Check the circulation pipes. It is not a controller problem.

Troubleshooting Table				
Alarm	**#**	**Description**	**Symptom**	**Result**
Check CLRMTR connect	A3	Communication error between colorimeter and colorimeter board.	No Cl measurements.	Check wiring between colorimeter sensor and colorimeter board. Change colorimeter sensor in case of continued problem.
No reagents	A4	Reagents are empty.	No reading.	Check reagent level and change bottle if needed. Make sure the sensor is not stuck.
Stuck piston	A5	The piston is not moving properly within the colorimeter.	No chlorine measurements. No chlorine dosing.	Wait for the second measurement and check visually. Clean the colorimeter assembly. Make sure the colorimeter connection is well-connected to the "mixer" on the control panel. The other possibility is that there is not enough flow to the colorimeter. Increase the flow to the analyzer.
Unclean cell	A6	Impurities have accumulated in the colorimeter analyzing cell.		Clean the tube with a cotton swab. Other possibility is that there is not enough flow to the colorimeter. Increase the flow to the analyzer. Frozen solenoid valve.
Replace light	A7	LED in colorimeter is not working. Insufficient connection on the board.		Re-solder LED connection. Change colorimeter assembly.
Low reagents	A8	Reagents are below 20%. Notifies how many days until the reagents are depleted.	Blue LED will flash – message only.	Message only – NOT an error. Indicates reagents are needed soon.
Chlorine < 0.1	A9	Chlorine level is below 0.1 PPM	No chlorine dosing	Compare to manual reading. If normal operation will be around 0.1 ppm range, then disable alarm.

Troubleshooting Table				
Alarm	#	Description	Symptom	Result
Low chlorine	A11	Cl below lower limit.	Message only	Compare to manual reading. Check reagent flow from bottle to colorimeter. Check/clean solenoid valve (including spring). Check water flow. Verify piston movement ('mixing"). Check that dosing systems are operating properly.
High chlorine	A12	Cl above upper limit.		Compare to manual reading. Check reagent flow from bottle to colorimeter. Check/clean solenoid valve (including spring). Check water flow. Verify piston movement ('mixing"). Check that dosing systems are operating properly.
Low pH	A13	pH below lower limit	--	Compare to manual reading and recalibrate if necessary. Check if unstable reading is due to poor grounding. Increase high/low pH level if operation is normal. Replace probe.
High pH	A14	pH above upper limit.		
External Off alarm	A17	External flow switch is off. No chemical dosing (all relays are open).		Make connection on I/O board with flow sensor on connections 5 + 6 or with jumper wire to complete circuit. Not recommended to operate with jumper only.
Total Cl high	A18	Total Cl above upper limit.		Compare to manual reading. Check reagent flow from bottle to colorimeter. Check/clean solenoid valve (including spring). Check water flow. Verify piston movement ('mixing"). Check that dosing systems are operating properly.
Combine Cl high	A19	Combined Cl above upper limit.		--
Replace DPD3	A20	DPD3 low.	No reagent in the right bottle out of the three	Replace Total Chlorine reagent
Temp. low alarm	A21	Temperature below lower limit.	--	--
Temp. high alarm	A22	Temperature above upper limit.		

Troubleshooting Table				
Alarm	#	Description	Symptom	Result
Cl over-feed time	A23	Cl dosing on for longer than max time and has shut off for safety reasons.	Cl dosing stops until reset.	Confirm proper operation of dosing systems and perform a system reset.
pH over-feed time	A24	pH dosing for longer than max time.	pH dosing stops until reset.	
No emergency		No problem to allow ORP emergency mode.		-
* No dosing only affects the relay operation. Alarm relay will close and all other relays will open.				

Troubleshooting		
Problem / Symptoms	Potential Cause	Solution / Suggestion
Chlorine measurement is zero or low	Reagent pumps not primed or broken.	Prime for 90 seconds – confirm pumps work properly and droplets form and drop from each needle.
	Chlorine too high (> 10ppm) and is bleaching reagents.	Dilute and test manually – controller will operate fine once back in normal level.
	Solenoid not shutting completely.	Confirm that water stops flowing when reading starts (timer gets to zero). Unscrew solenoid and clean the tip – check filer for holes.
	Using wrong or not original reagents or reagents have passed expiration date.	Make sure reagents are in good condition, replace if needed.
	Needles blocked/damaged.	Turn reagent pumps ON and confirm that droplets are forming as expected.
	Valve malfunctioning.	Check/clean valve and spring. Add grease. Replace valve if necessary.
	Needle is cracked or tube split at needle.	Needle will be back on outside – DPD occasionally does not drop properly b/c not flowing through needle.
Chlorine measurement inconsistent	Cl averaging on.	Check if Cl averaging on in Tech menu – turn off if not wanted.
	Calibrated at wrong level.	Enter calibration – enter password and press enter to accept reading from colorimeter.
	Valve malfunctioning.	Check/clean valve and spring. Add grease. Replace valve if necessary.
	Needs calibration (near set point)	If +/- 25% of set point, re-calibrate.

Replacing Components

The following procedures describe how to replace certain Chlorine XP components.

CAUTION: The following procedures should only be performed by properly qualified and trained Chlorine XP analyzer technicians.

WARNING: Disconnect all power supplies to the Chlorine XP analyzer before opening the control unit door. Replacing any parts of Chlorine XP analyzer without the expressed written authorization of Thermo Fisher Scientific or the qualified representative who supplied the product may void the warranty.

Thermo Fisher Scientific takes no responsibility, written or implied, for installation or maintenance of Chlorine XP that is not performed by a properly trained and certified Chlorine XP technician.

Replacing Reagent Siphons

1. Turn the power off to the analyzer.
2. Disconnect the two (2) red wires from the reagent level connector on the colorimetric module.
3. Remove the four (4) mounting screws.
4. Install the new reagent siphons.
5. Attach the four (4) mounting screws.
6. Connect the two (2) red wires to the colorimetric module.

Replacing the Reagent Level Sensor

1. Turn the power off to the analyzer.
2. Disconnect the two (2) red wires from the reagent level connector on the colorimetric module.
3. Unscrew the old sensor by hand and pull out the sensor along with its 2 red wires.
4. Install the new sensor by first pushing the 2 red wires into the sensor tube.
5. Screw in the sensor by hand.
6. Reconnect the 2 red wires to the colorimetric module.

Replacing Reagent Pumps

1. Turn the power off to the analyzer.
2. Disconnect both pipes from the reagent pump.
3. Remove the four (4) mounting screws.
4. Disconnect the Red and Blue wires from the Pumps connector on the colorimetric module.

5. Install the new pump and reconnect (in this order): the pipes, the 4 screws and the wires to the colorimeter module.

6. Turn the reagent pumps on until reagents are injected into the colorimeter cell (approximately 90 Sec.).

Note: If only the motor is to be replaced, the pump head will need to be removed and reattached. Please refer to the section "Replacing Reagent Pump Head and Tubes".

Replacing Colorimeter

The Chlorine XP water quality analyzer's colorimeter is a self-contained chlorine analyzing cell to determine the chlorine concentration in the water.

Follow the procedure below to replace the colorimeter.

1. Turn off the water inlet and outlet from the flow cell and turn off the analyzer power.

2. Open the doors of both the analyzing module and the control module.

3. Locate the colorimetric cell unit in the analyzing sets.

4. Disconnect the existing Colorimeter:

    a. Remove the top cap from the colorimetric unit.

        i. Make sure not to touch the reagent injection needles in the cap.

    b. Disconnect the outlet tube from the colorimetric unit.

    c. Unscrew the union between the solenoid valve and the Colorimeter.

    d. Unscrew the four (4) mounting screws that hold the Colorimeter to the Chlorine XP housing.

5. Open the control module door.

6. Trace the wires from the Colorimeter to the colorimeter control module connector. A total of five wire pairs (2x5) are connected to the control module (4 connected to the "MIXER" terminal block and 6 to the horizontal plug at the bottom of the circuit board).

7. Disconnect the Colorimeter's wires from the Colorimeter module.

8. Connect a new Colorimeter unit:

    a. Hand-tighten the union between Colorimeter and the solenoid valve until the Colorimeter is tightly connected to the valve. Check that the O-ring is still in place.

    b. Screw the Colorimeter to the Chlorine XP analyzing module housing with the four mounting screws.

    c. Place the top cap on the Colorimeter unit.

9. Re-connect the outlet tube to the Colorimeter.

10. Pass the wires from the new colorimeter through the gasket into the control module.

11. Connect the wires to the "MIXER" and "SENSOR" terminal blocks as indicated on the colorimeter module.

12. Recheck all connections.

13. Close the Chlorine XP analyzing module door.

14. Turn on the power and restore flow to the flow cell.

15. Confirm that the colorimeter is operating properly.

Replacing Colorimeter Solenoid Valve

1. Turn the water inlet and outlet to the flow cell and turn off the analyzer power.

2. Release the top union connecting the solenoid valve to the Colorimeter module.

3. Detach the cable from the solenoid valve.

4. Unscrew the solenoid valve intake tube.

5. Unscrew and disconnect the sampled water supply pipe from the solenoid valve intake pipe at the bottom of the solenoid valve.

6. Disconnect the valve from the unions above and below.

7. Connect the new solenoid valve.

    a. Connect the bottom of the new valve to the intake pipe.

    b. Insert an o-ring into the slot at the bottom of the intake pipe, and turn until the intake tube is firmly connected to the new valve.

    c. Connect the top union to the valve and to the bottom of the Colorimeter unit and tighten.

8. Connect the solenoid valve cable to the Colorimeter module.

Replacing Control Panel Module (electronics card)

Disconnect the power supply to the unit before opening the control unit.

1. Disconnect the flat cable plug from the card.

2. Unscrew the four (4) mounting screws.

3. Put in the new card and tighten the 4 mounting screws.

4. Connect the flat cable plug to the card.

Figure 7: Replacing all types of electronic modules (cards)

Replacing I/O Module

Disconnect the power supply to the unit before opening the control unit.

1. Disconnect the flat cable plug from the card.

2. Unscrew the four (4) mounting screws.

3. Put in the new card and tighten the 4 mounting screws.

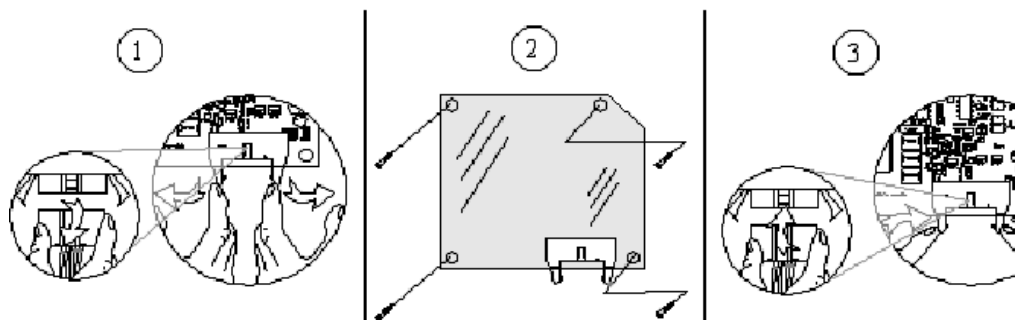4. Connect the flat cable plug to the card.

Replacing Colorimetric Module

Disconnect the power supply to the unit before opening the control unit. If pH and/or Temperature are being measured, first remove the pH and Temperature card.

1. Disconnect the flat cable plug from the colorimetric card.

2. Unscrew the four (4) mounting screws.

3. Put in the new colorimetric card and tighten the 4 mounting screws.

4. Connect the flat cable plug to the colorimetric card.

Module Software Update

Each electronic module (card) has a microcontroller chip (IC) with its own unique software. Whenever a module's software is updated, its chip must be replaced by a new version with the new software*.

1. Turn OFF the power to Chlorine XP analyzer.

2. Locate the chip that needs to be replaced.

3. Remove the chip carefully by prying up each end a little at a time with a thin screwdriver.

4. Install the new chip in the same location. Please note in the figure that the chip and the board each have a directional mark. The chip must be positioned so that these directional marks are aligned.

*The control panel has no IC, it is necessary to replace the module (electronics card).

WARNING: Installing the chip in the wrong direction will damage the system and can create an electrical fire hazard.
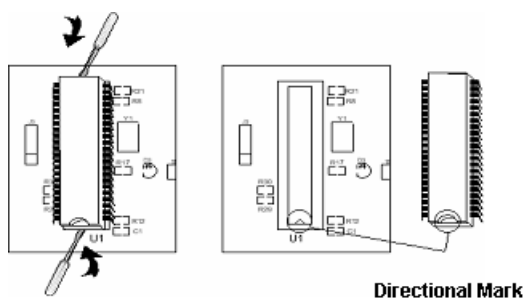
Figure 8: Installing new chipset

Directional Mark

6

SECTION 6 — Additional Measurements and Features

Additional Measurements

The following additional measurements may be added to Chlorine XP:

- Free + Total Chlorine monitoring (instead of just free or total)
- pH
- Temperature
- Flow Rate

Free + Total Chlorine Measurements

Installation

The Free Cl + Total Cl measurements are an optional feature that is supplied from the factory. However, in addition to the standard free chlorine set-up, some additional steps are required.

Installing DPD3 Reagent

The DPD3 reagent bottle is installed the same way as the DPD1 Indicator and Buffer solution bottles. The DPD3 reagent will be in a 600 ml bottle labeled as DPD3.

1. Place the reagent bottle in position:

    a. Remove the cap from the reagent bottles.

b. Place the opening of the reagent bottle below the bottle siphon on the right.

c. Lift the bottle up until the opening reaches the bottle siphon cap.

d. Push the lever above the siphon cover away from you, and push the reagent bottle up.

e. Push the bottom of the bottle into position

2. Prime the reagent pump for ninety (90) seconds until the reagent drops are visible through the DPD3 needles.

a. Turn reagent pumps on from the operator menu.

Additional Menus and First Time Set-up

In order to operate the free and total chlorine measurements, a few additional menus are required. The menus and their descriptions are listed below. The settings in these menus will need to be configured before operation. The tables below outline the menus specific to Total Chlorine monitoring in the operator and technician menu.

Additional Menus in the Operator Menu	
Name	Description
TC High Alarm	Alarm when the Total Chlorine is above this value
CC High Alarm	Alarm when the Combined Chlorine is above this value

Additional Menus in the Technical Menu	
Name	Description
Tot Chlor	Turns the total chlorine monitoring and display On or Off
Chlor Ratio	The ration of Free Chlorine measurements to Total Chlorine Measurements

Activate Total Chlorine Monitoring

1. Enter the Operator Menu.

2. Set the TC High Alarm Level.

3. Set the CC High Alarm Level.

4. Enter the Technician Menu (by pressing up and down together).

5. Press Menu until "Total Chlor ON/OFF" appears.

6. Change to "ON" (the default is - OFF).

7. Press Menu unit until "Chlor Ratio" appears.

8. Select the ratio of total chlorine measurements.

The frequency of total chlorine testing will be based on the chlorine interval and the chlor ratio. If the Chlor Ratio is 1, the total chlorine will be tested every cycle. If the Chlor Ratio is greater than 1, the Total chlorine will be tested every few cycles. For example, if the Chlor Ratio is 5, the total chlorine will be tested after every 5th Free chlorine test.

9.   Perform a system reset to start operating in TC mode.

10. Locate the LCD displays in the Chlorine XP control panel. A number should appear in the display (TCl - 0.00) and will update after the first total chlorine test.

Routine Maintenance

Reagent Replacement

Reagent replacement should be done after the message "Replace DPD3" appears on the LCD. Refer to "Installing DPD3 Reagent" Section for information on reagent replacement.

Calibration

Calibration of the free chlorine will automatically update/calibrate the total chlorine.

pH and Temperature Measurements

Installation

If the Chlorine XP system was ordered with these components some steps in this process will have been completed in the factory and may be skipped.

Required Components:
- pH, Temp Module (electronics card)
- pH probe cable
- 150 mm flat cable
- pH probe
- Temperature probe

Note: The system must always have the temperature probe as this provides additional grounding to ensure reliable pH measurements.

The following procedure describes how to install pH sensors in the Chlorine XP unit. The installation of all the sensors in the flow cell is similar, except for the connecting wires.

CAUTION: Make sure the pH sensors have plastic or rubber plugs covering their ends. Use another sensor if the plug of any sensor is missing or has fallen off.

Make sure to connect the appropriate wires to their respective sensors. Labels are located on the wires near the probe connection and on the pH and Temp Module.

1.   Turn off all power and water supplies to the analyzer.

2.   Install the pH and Temp module (electronics card) in the control module on the top left (above the colorimeter module, if present) using the 4 supplied screws.

3.   Connect the flat cable to the pH and Temp module to an open connector on the I/O module.

4. Install the temperature probe:

   a. Thread the 3/8" compression connector into the back of the flow cell.

   b. Place the probe into the connector until and the connector is tightened.

   c. Route the temperature probe wires into the electronics box and connect to the pH and Temp module following the color codes listed on the module.

5. Install the pH probes:

   a. Remove the sensor from its packing box and remove the plastic cover or plug from the end of the sensor and drain the solution from the tube. Keep the plastic cover in a safe place for winterizing or storage of probes.

   b. Hold the sensor by its connector, with the glass tube pointing down.

   c. Insert the sensor into ½" connector on the top of the transparent flow cell and thread in securely. DO NOT OVERTIGHTEN.

   d. Route pH cables to the electronics box and connect to pH and temp module.

   e. Connect each cable to the appropriate sensor.

6. Repeat step 5 for additional sensors. If only 1 sensor is installed:

   a. Install a jumper between the inputs for the missing probe.

   b. In the menu, set the low and high alarm limits at the minimum and maximum values respectively to prevent a false alarm for a measurement that is not connected.

7. Switch the Chlorine XP ON and verify that pH readings appear on the display. In some analyzers, this may need to be turned on in the technical menu.

8. Observe the pH levels and wait several minutes until both readings stabilize.

   a. If either one or both indicators do not display a proper reading or are not stable confirm proper installation and then see the Troubleshooting section.

Routine Maintenance

Calibration

pH Calibration

pH is calibrated using a Phenol Red or Buffer 7 solution.

1. Shut off the water inlet and outlet from the flow cell.

2. Remove the pH sensor and temperature probe from the flow cell.

3. Wipe the sensor probe with a dry cloth and submerge it and the (PT-100) temperature probe into a cup with the Phenol Red or Buffer 7 solution. Wait for the reading to stabilize.

   Note: The reading will not stabilize if the temperature probe is not also in the buffer solution.

4. Press Menu until "pH Calibrated to" appears in the LCD display.

5. Press OK.

6. Enter the password. Press the up arrow or down arrow until the password is reached.

7. Press OK.

8. Press OK again.

9. Press the up arrow or down arrow until the value is the same as the value printed on the label of the Phenol Red or Buffer 7 Solution.

10. Press OK to save the new calibration or Esc to abort without saving.

11. Press Esc to return to the main display.

Note: When the Chlorine XP is initially turned on, the pH readings will continue to rise for the first 24-48 hours. If calibration is required, it is best to wait until the readings have stabilized or recalibrate when the readings have stabilized.

Temperature Calibration

Take a sample of water from the flow cell:

1. Insert a digital thermometer into the sample.

2. Wait for the thermometer reading to stabilize.

3. Press Menu until "Temperature Calibrated to" appears in the LCD display.

4. Press OK.

5. Enter the password. Press the up arrow or down arrow until the password is reached.

6. Press OK.

7. The value that appears is the last calibrated value.

8. Press OK again.

9. Press the up arrow or down arrow until the value is the same as the independent digital thermometer.

10. Press OK to save the new calibration or Esc to abort without saving.

11. Press Esc to return to the main display.

Replacing Sensors

Replacing the pH sensor

1. Turn off the inlet and outlet water to the flow cell and the power to the analyzer.

2. Open the doors of both the analyzing module and the control module.

3. Locate the sensor in the flow cell that is to be replaced. The specific sensor may be identified by the label on the wire or by tracing the wire from the control panel back to the sensor.

4. Remove the old sensor from the flow cell:

   a. Unplug the sensor's wires from the sensor, by grabbing the connector at the top end of the sensor and unscrewing the connector.

   b. Unscrew the sensor from the flow cell.

   c. Pull the sensor up until its glass tube clears the hole.

5. Install the new Sensor:

   a. Open the replacement sensor's box, and remove the sensor by the metal connector.

   b. Remove the plastic cap on the glass end of the probe.

   c. Hold the sensor by its metal connector, with the glass tube pointing down, and insert the glass tube into a hole in the flow cell.

   d. Screw the probe into place. DO NOT OVERTIGHTEN.

   e. Attach the sensor wire onto the probe.

Replacing the Temperature Probe

1. Turn off inlet and outlet water to the flow cell and power to the analyzer.

2. Open the doors of both analyzing module and control module.

3. Remove four (4) wires from the temperature probe in the control module.

4. Remove the old sensor from the reading cell:

   a. Unscrew compression fitting from the temperature probe.

   b. Pull the probe up until it clears the fitting.

5. Install new sensor:

   a. Insert new temperature probe into the fitting.

   b. Screw the compression fitting around the new probe.

   c. Connect wires to pH and Temp module following color coding.

Replacing pH and Temperature Module

Disconnect the power supply to the unit before opening the control unit.

1. Disconnect the flat cable plug from the card.

2. Unscrew the four (4) mounting screws.

3. Put in the new card and tighten the 4 mounting screws.

4. Connect the flat cable plug to the card.

Shut-down and Winterizing

1. Remove the probe from the flow cell.

2. Fill the rubber caps (that were on the new probes) with tap water or preferably KCl (potassium chloride) solution and insert over the end of each probe (DO NOT use DI water).

3. Screw the plastic cap over the top of each probe to protect the connector.

4. Store in a safe location that will not drop below freezing, preferably in the original probe box for additional protection.

Flow Meter

Thermo Fisher Scientific does not supply flow meters; only input connections and display.

Installation

Required Components

- Flow meter – frequency or 4-20
- 4-20 input module if using 4-20 flow meter
- 150 mm flat cable if using 4-20 input module

Prior to opening the analyzer or installing any electrical components, turn off all power supplies to the analyzer.

Frequency Output Flow Meter

A flow meter with either two (2) or three (3) wires for a frequency output can be connected to the input switch section on the I/O module.

Installation:

1. Install the flow meter following the manufacturer directions. Be sure to install close enough to Chlorine XP that the wires will reach.

2. Pass the flow sensor cable through an open glad on the bottom of the analyzer.

3. Connect the two or three wires from the sensor cable to the input switch terminal block on the lower right corner of the I/O Module.

4. Although the flow meter is connected, it will not operate until it is set-up in the analyzer menu.

5. Press Menu until "Flow Low Limit" appears. Enter the low flow value (the flow value which will cause an alarm and will disable any direct chemical dosing).

6. Change to "Flow Sensor" on.

7. Press Menu again and "K-factor" appears. Enter the k-factor for the flow meter being used (should be on paperwork with flow meter).

8. Press Up + Down arrows together and then press Menu until "Flow Rate m3/hr" appears. Select the flow units of m3/hr or GPM.

4-20 Output Flow Meter

Any flow meter with a 4-20mA output can be connected to the analyzer's internal 4-20 input module.

1. Install the flow meter as per the manufacturer directions.

2. Pass the flow sensor cable through an open glad on the bottom of the analyzer.

3. Connect the 4-20mA output wires from the flow meter to the middle 4-20mA Input connection on the input module.

4. Although the flow meter is connected, it will not operate until it is set-up in the analyzer menu.

5. Press Menu until "Flow Low Limit" appears. Enter the low flow value (the flow value which will cause an alarm and will disable any direct chemical dosing).

6. Press Up + Down arrows together and then press Menu until "Flow Rate m3/hour m3/hr" appears. Select the flow units of m3/hr or GPM.

7. Press Menu until "Max flow Range" appears. Enter the maximum flow rate (flow rate at 20mA output). The minimum flow rate (flow rate at 4mA output) is assumed to be zero.

8. The flow meter should now be active. Confirm that the flow rate appears on the LCD display. If it is not active, perform a system reset.

Routine Maintenance and Troubleshooting

Follow manufacturer's recommendations for maintenance procedures and any troubleshooting issues.

Modbus Communication Protocol

Modbus is a serial communications protocol, which allows for communication between many devices connected to the same network. Modbus is configured via the technician menus.

1. To enter the Technician menu, press Menu to enter the operator menu and then press the up arrow and down arrow simultaneously until the menu display changes.

2. Locate the "Modbus com format" in the menu:

    a. Press Menu until the desired parameter name appears in the LCD display.

    b. Press OK. "Enter Password 100" appears on the LCD display.

3. Enter the Technician menu password:

    a. Press the up arrow or down arrow until the correct password number is reached.

    b. Press OK. The parameter name and current setting appear in the LCD display.
    Note: The technician menu password is different from the Operator menu password. The default Technician menu password is 456 and if lost, can only be reset by replacing the chipset.

4. Press OK again. The LCD display shows the parameter and the current setting.

5. Enter the new parameter setting:

a. Press the up arrow or down arrow until the desired parameter value is reached, according to the options listed in the following table.

b. The second row of the menu display, below the value that is being changed, shows the current value.

6. Press Enter to save the new setting or Esc to abort without saving the new setting.

Modbus Configuration Options					
Parameter's value	Bit 4 2 stop / 1 stop bit	Bit 3 Floating point / Swapped floating point	Bit 2 19200bps / 9600bps	Bit 1 Party Even/ odd	Bit 0 Parity / No parity
0	0	0	0	0	0
1	0	0	0	0	1
2	0	0	0	1	0
3	0	0	0	1	1
4	0	0	1	0	0
5	0	0	1	0	1
6	0	0	1	1	0
7	0	0	1	1	1
8	0	1	0	0	0
9	0	1	0	0	0
10	0	1	0	0	1
11	0	1	0	1	0
12	0	1	0	1	1
13	0	1	1	0	0
14	0	1	1	0	1
15	0	1	1	1	0
16	0	1	1	1	1
17	1	0	0	0	0
18	1	0	0	0	1
19	1	0	0	1	0
20	1	0	0	1	1
21	1	0	1	0	0
22	1	0	1	0	1
23	1	0	1	1	0
24	1	0	1	1	1
25	1	1	0	0	0

Modbus Configuration Options					
Parameter's value	Bit 4 2 stop / 1 stop bit	Bit 3 Floating point / Swapped floating point	Bit 2 19200bps / 9600bps	Bit 1 Party Even/ odd	Bit 0 Parity / No parity
26	1	1	0	0	1
27	1	1	0	1	0
28	1	1	1	0	1
29	1	1	1	0	0
30	1	1	1	1	0
31	1	1	1	1	1

Modbus communications mapping is detailed in the Relays and Their Controlled Dosing Systems table.

Modbus Communications Options			
Parameter's Name	Type	Address	Notes
Chlor main pump	Coil	0	
Chlor Addition. pump	Coil	1	
Acid/ Base Pump	Coil	2	
Temperature control	Coil	4	
Alarm Lamp	Coil	5	
Low Reagent	Discrete Input	10015	
Alkali/Acid	Discrete Input	10016	
Flow sensor connection	Discrete Input	10017	
Chlorine averaging enable	Discrete Input	10019	
Chlorine <0.1 alarm enable	Discrete Input	10020	
Celsius/Fahrenheit	Discrete Input	10021	
Total Chlorine On/Off	Discrete Input	10022	
M3/H / GPM	Discrete Input	10023	
Free chlorine On/Off	Discrete Input	10024	
pH On/Off	Discrete Input	10026	
No Flow	Discrete Input	10032	
Low Flow	Discrete Input	10033	
No Reagents	Discrete Input	10034	
Chlorine<0.1	Discrete Input	10035	
Unclean cell	Discrete Input	10037	
Replace light	Discrete Input	10038	
Low chlor.	Discrete Input	10039	
High chlor.	Discrete Input	10040	

Modbus Communications Options			
Parameter's Name	Type	Address	Notes
Low Ph	Discrete Input	10041	
High Ph	Discrete Input	10042	
External OFF	Discrete Input	10046	
Colorimetr comm. error	Discrete Input	10047	
High total chlor	Discrete Input	10048	
High combine chlorine	Discrete Input	10049	
No DPD3	Discrete Input	10050	
Chlor overfeed time	Discrete Input	10051	
Ph overfeed time	Discrete Input	10052	
Piston stuck	Discrete Input	10053	
Low temperature	Discrete Input	10054	
High temperature	Discrete Input	10055	
Free chlorine	Input Register	30000	Floating point IEEE-754
pH	Input Register	30002	Floating point IEEE-754
Temperature	Input Register	30006	Floating point IEEE-754
Flow	Input Register	30008	Floating point IEEE-754
Total chlorine	Input Register	30012	Floating point IEEE-754
Combine chlorine	Input Register	30014	Floating point IEEE-754
Colorimeter alarms	Input Register	30018	bit0 - Low Reagent bit1- No Reagents bit2 - No DPD3 bit3 - No Flo bit4 - External OFF bit5 - Unclean cell bit6 - Replace light bit7 - Colorimeter communication Error bit8 - Piston stuck

Communication Options

Internal 4 to 20mA Output

Installation

Required Parts

- Internal 4-20mA Module (electronics card)
- 250mm Flat Cable (ribbon cable)
- 2 wire cables for each channel/parameter

Hardware Installation

1. Attach the 4 to 20 module to the inside of the control panel door below the control panel module using the 4 supplied screws.

2. Attach the ribbon cable from the 4 to 20 module to any open connector on the I/O module.

Electrical Installation

The 4 to 20 mA module is powered through the ribbon cable and does not require a separate electrical supply as the external module.

Configuration

For Free Cl only, the 4-20mA output may be set to Read or Control.

- Read Mode will operate like the standard 4-20mA output and send an output related to the measured value. See Internal 4 to 20mA Output.
- Control Mode will send an output to control the feed system based on:
  - Measured value
  - F-Cl set-point 1
  - Cl P-factor

The Control Mode has 2 options: normal and inverted ("Invert" in the menu)

- Normal:
  - 4mA = No Cl Dosing
  - 20mA = Max Cl Dosing
- Inverted:
  - 20mA = No Cl Dosing
  - 4mA = Max Cl Dosing

The menu for "4-20mA output settings" is found on the technician menu.

1. Set the 4-20mA outputs.

   a. Enter the technician menu and scroll until "4-20mA output settings" appears in the LCD.

   b. Press OK.

      i. Enter the technician password and press OK.

   c. Select Channel.

      i. Select "Built-in ch. # "(1 - 2) and press OK.

   d. Select Parameter (F-CL, pH, Temp, Flow, T-CL, C-CL) and press OK.

      Note: Optional features appear in the selection as well.

   e. Select "read" or "control" function (for F-CL only)

      i. If control was selected, set control to "Normal" or "invert" and press OK.

   f. Select "Set value for 4mA" and press OK.

g. Select "Set value for 20mA" and press OK.

h. Select "Set Test channel" (to be used for troubleshooting purposes or initial tests): 2mA, 4mA, 12mA, 20mA and press OK.

i. Press Escape to return to the set-up menu and repeat the above steps for all active 4- 20mA.

2. Set the 4-20mA alarm.

This is the 4-20mA output value that will indicate whenever an alarm condition exists or communication between the analyzer and 4-20 module is interrupted.
In the technician menu:

a. Select the "on alarm to go to" option.

b. Select the desired "output" 2mA, 4mA, 20mA or hold.

Note: The alarm will not activate at low or high chlorine levels. It will only go on in case of low or no flow and /or when there is a communication failure between the analyzer and the mA output i.e. power failure.

Confirming Operation and Communication

Prior to connecting to the external monitoring or control system, it is best to confirm that all desired outputs are working properly using a digital multimeter. This must be done without output wires connected to an external system.

1. Set the multimeter to measure current and connect the multimeter to an active output (an output is inactive if it does not have a chipset installed next to the terminal block).

2. Record the current in mA.

3. Confirm that the value is accurate using the following equation.

4. Repeat for each active output.

$$mA = \frac{(16)*(MeasuredValue - MinValue)}{FullScale} + 4$$

mA = milliamp output value
Full Scale = Max Value - Min Value (in case of Min is zero, it's the max value)

Connecting to an External Monitoring System

1. Connect two wires from the active output to the appropriate connection on the external system

2. Repeat for each active output.

3. If an active output (output with a chipset installed) is not to be used, place a jumper wire between the contacts.

7

Relays and Closed-Loop Control

There are 6 dry-contact relays on the I/O module. Five of the relays may be used for direct control of closed-loop systems. All of the relays may be used as dry-contacts and will operate based on the settings, specifically the set-points, selected in the operator menu.

Connecting External Equipment to the Relays

This is only required if the relays are being used to power and control external dosing equipment. The relays will act as dry contacts if no power is supplied. A dependent power supply should be used such that no equipment will be activated unless the process line has flow.
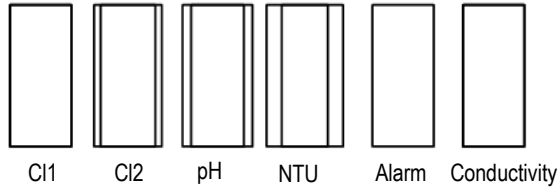
Wiring to Dosing Systems

Chlorine XP controls chemical dosing systems using a series of electronic relays that start and stop the dosing pumps. Each relay opens and closes a switch that activates a separate pump or piece of equipment.

The line (live) wire of the dependent power source connects to the connection labeled "Common" on each relay. The line wire of each controlled system is connected to the normally open (NO) or normally closed (NC) connection of each relay as appropriate. Normally Open means that the relay will be open (i.e. no power from the relay) until the controller calls for power; Normally Closed means that the relay will be closed (i.e. power from the relay) until the controller calls to stop power.

1. Verify that the power switch or circuit breaker to the dependent power source is off.

2. Connect the earth wire to the ground return wire from each of the external dosing systems.

3. Connect the neutral wire to the return wire from each of the external dosing systems.

4. Connect the line (live) wire to the connector marked Common of each active relay.

CAUTION: Each relay connection is limited to 4 amps, to prevent overheating. The relays may show a higher rating but do not connect equipment exceeding 4 amps.

Figure 9: Relay positions on board

CI1   CI2   pH   NTU   Alarm   Conductivity

The following table lists the relays and the dosing systems they control:

| Relays and Their Controlled Dosing Systems		
Relay #	Relay name	Control
1	CL1	Main Chlorine system. On/Off or Proportional. Proportional controls pulse length or pulse frequency (PL/PF). This relay can be replaced when overheated.
2	CL2	Secondary Chlorine system (On/Off only – no proportional control).
3	pH	Acid or Base dosing. On/Off or Proportional. Proportional controls pulse length or pulse frequency (PL/PF). This relay can be replaced when overheated.
5	Alarm	Activates an external alarm when certain alarm types are registered and after the alarm delay time has expired.

Replacing Relays

As noted, Relays 1 – CL1 and 3 – pH are replaceable relays that you can replace and install new ones when required.

1. Remove the retainer clip.

2. Pull the relay out.

3. Install the new relay by matching the pin configuration on the back of the relay and pressing into the socket.

4. Reinstall the retainer clip.

Proportional Control Overview

The Chlorine XP analyzer controls dosing proportionally. This method sets dosing rates in relation to how far current chemical levels are from the set point. The dosing rates gradually decrease as chemical levels get closer to the set point.
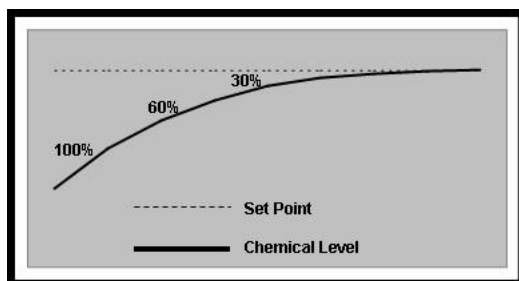
Proportional Factor

Proportional control of chemical dosing requires configuration according to various factors. The primary factors are the ratio between the system size and the rate the chemical dosing systems can feed chemicals, and the delay time between when the chemical level changes and when it is sensed by the controller.

In large systems, changes in chemical levels occur slowly. The dosing systems must feed large amounts of chemicals for a long period of time in order for a change to be noticed. The chemicals also disperse slowly in larger systems. Smaller systems, on the other hand, react much more quickly.

The length of time between the change and when the controller identifies the change also affects proportional control. The controller can only identify water chemical levels after they have been distributed throughout the system and have returned to the analyzer. This lag time varies for each system and in general, systems with shorter lag-times will operate better with high P-factors and systems with longer lag-times will operate better with low P-factors.

The following figure explains the process of determining the chlorine P factor.

Note: After each cycle of dosing, please take into account the system cycle time e.g. the time it takes the chlorine to dissolve in the water reservoir, before measuring the chlorine levels.

Figure 10: P-factor computation example
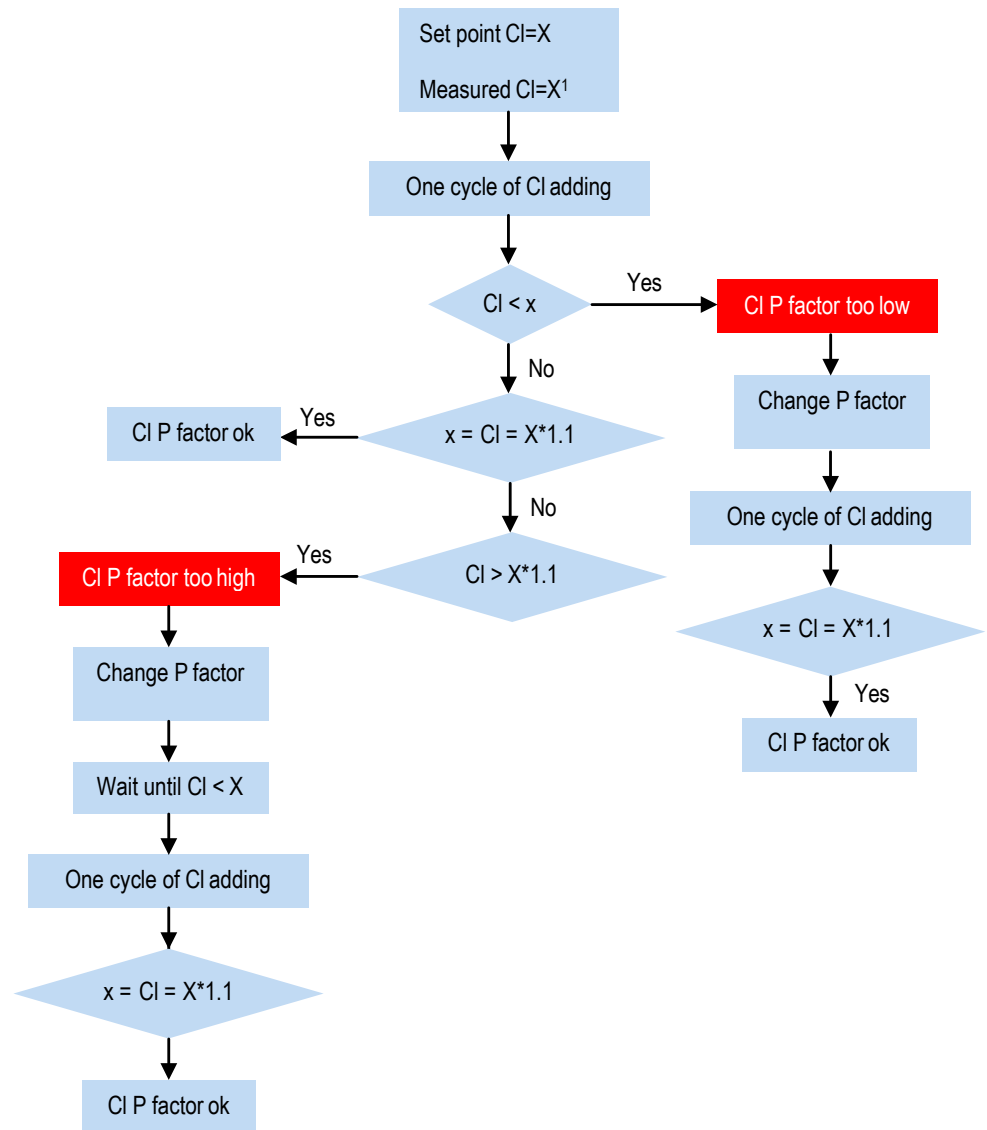
Step By Step Proportional Settings

1. Finish the installation of all controllers (electrical, water, feeding systems and electrodes).

2. Calibrate the controller to the water chemical values at the sample point.

3. Set the proportional factor and the pump period of the chlorine and the pH at an initial setting.

4. Let the controller operate the chlorinator and the pH correction devices and make sure that chemicals are injected into the water.

5. Watch the chlorine and pH as they change. We recommend that you record the values frequently so that the process is closely monitored.

   a. If the values greatly exceed the set point, you need to decrease the proportional factor.

   b. If it takes too long to get to the set point, you need to increase the proportional factor.

Note: In large systems the delay time between injection of the chemicals and receiving the change in the controller can be very long (30 minutes or more).

Setting Pump Period

Pump period is a single cycle during which the dosing pump operates and then rests. Proportional control divides the pump period into two distinct phases: active and at rest.

In general it is recommended to operate in a short cycle, i.e., 00:30 Sec. For large systems, or if you activate solenoid valves, you may consider longer pump periods.

8

S E C T I O N 8 **Technical Specifications**

Mechanical Data	
Dimensions (Controller) (W x H x D)	14" x 7" x 5" (330 x 670 x 130mm)
Cable Entries	Pg 9 cable glands
Ingress Protection	IP 65 (NEMA 4 equivalent)
Max. Ambient Temperature	15ºF to 131ºF (-10ºC to 55ºC)
Weight Approx.	11 lbs. (4.5 kg)

Electrical Connection	
Power Supply	100-240VAC/1.8A
Power Consumption	Approx 60 VA
Power Supply for RTC Memory	3.6V lithium battery

Data Serial Output/Signal Output	
RS 485	Standard
4-20mA	Optional

Relays	
CL (Chlorine) Set Point 1	250VAC/DC 4A max
CL (Chlorine) Set Point 2	250VAC/DC 4A max
pH 1	250VAC/DC max
General Alarm	250VAC/DC 4A max
Temperature Control	250VAC/DC 4A max

Display	
5.5" large graphic monochrome display	
Character LCD with background light alarms and status	

pH Measurement	
Measurement Range	0-14
Sensor	Ceramic diaphragm and gel filling input
Impedance	$0.5. 10^{12}\Omega$

Reagents	
Reagent Type	DPD1, DPD3, DPD4
Reagent Use	~0.033 ml per sample
Average Consumption	1-2 months
Shelf Life	Unmixed DPD1 & DPD4 36 months DPD3 15 months Mixed 60 days

Flow Monitoring	
Sensor	Inductive Proximity sensor
Output Signal	Dry contact
Inlet Pressure	Min 4.4 psi (0.3 bar) - Max 14.5 psi (1 bar)
Outlet Pressure	13 psi (0.9 bar)

Ph Valve Control	
Control Function	P or PI or On/Off or frequency
Characteristics	Normal / Inverted
Relay Function	Pulse length proportional controller Pulse frequency proportional controller

Chlorine Control #1	
Control Function	P or PI or On/Off or frequency
Proportional Band	Yes
Relay Function	Pulse length proportional controller Pulse frequency proportional controller

Chlorine Control #2	
Control Function	On/Off
Proportional Band	No
Relay Function	Pulse length proportional controller Pulse frequency proportional controller

Temperature Measurement	
Sensor	PT-100
Measuring Range	32ºF to 212ºF (0ºC to 100ºC)

CI Measurement	
Indicator	Free and/or total chlorine
Measurement Principle	Colorimetric multi spectrum sensor
Working Temperature	33.8ºF to 113ºF (1ºC to 45ºC)
Measuring Range	0-10 ppm
Max. Operating Pressure	14.5 psi (1 bar)
Measuring Interval	2-10 min

Logger Data	
Memory	256K
Lines	1000
Recording Interval	1-360 min
Event Logger	Yes
Total Relay on Time	Yes

Security	
Operation Password	Yes
Technician Password	Yes

*Optional feature

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