

# GF 4630 Free Chlorine Analyzer System

## GF 4632 Chlorine Dioxide Analyzer System



3-4630-X3.090 Rev 2 02/22

## Operating Instructions

The GF 4630 System is EPA 334.0 Compliant.



### Description

The GF Chlorine Analyzer Systems are an integrated, all-in-one Chlorine Panel System designed to measure Free Chlorine or Chlorine Dioxide in drinking water and clean, fresh water treatment applications.

This manual applies to the 4630 Free Chlorine and 4632 Chlorine Dioxide Analyzer Systems.

#### Features:

- EPA 334.0 Compliant: The 4630 Free Chlorine System can be used for reporting chlorine residuals in accordance with EPA Method 334.0.
- Complete Chlorine Analyzer System allows quick setup and easy installation. Connect to a DC power supply and water source.
- Unique integrated clear flow cell combines sensors, flow regulator, filter and variable area flow indicator in one compact unit.
- Built-in variable area flow indicator facilitates flow rate confirmation at a glance.
- Integrated flow regulator with removable filter accepts inlet pressures of 1 to 8 bar (15 to 120 psi) while maintaining constant flow and minimal pressure to the sensors.
- Water flows vertically into sensor tip, eliminating bubble entrapment. Raised exit in flow cell sensor chamber ensures sensors stay submerged even when system and flow is turned off.
- Flow cell accommodates two sensors; one chlorine and an optional pH sensor.
- Automatic pH and temperature compensation or manual pH value input capability for accurate free chlorine readings.
- Easy viewing of the Chlorine Controller via the bright backlit LCD display.
- Moisture-proof NEMA 4X wiring enclosure.

Do not use the 4630 in systems that could have the absence of Chlorine.

Additional information can be found in the individual product manuals, refer to [www.gfps.com](http://www.gfps.com).

### Safety



#### CAUTION!

1. Follow instructions carefully to avoid personal injury.
2. Do not exceed the maximum pressure or temperature specifications.
3. In areas with elevated temperatures, mounting the Chlorine System in an outdoor box may cause damage to the system if the enclosure's internal temperature exceeds the temperature specification of the Chlorine Analyzer.
4. Do not alter product construction.
5. For use with clean fresh water only.
6. Disconnect from external power source before opening wiring enclosure.
7. This panel system may use AC voltages. Wiring should be done by qualified personnel only.

**WARNING:** The GF Chlorine Analyzer (electrode) is designed to be used in a clean, chlorinated flowing stream at all times. **DO NOT** use in applications where electrode could be exposed to periods without chlorine.



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- [Italiano](#)
- [中文](#)



## Warranty Information

Refer to your local Georg Fischer Sales office for the most current warranty statement.

All warranty and non-warranty repairs being returned must include a fully completed Service Form and goods must be returned to your local GF Sales office or distributor.

Product returned without a Service Form may not be warranty replaced or repaired.

GF products with limited shelf-life (e.g. pH, ORP, chlorine electrodes, calibration solutions; e.g. pH buffers, turbidity standards or other solutions) are warranted out of box but not warranted against any damage, due to process or application failures (e.g. high temperature, chemical poisoning, dry-out) or mishandling (e.g. broken glass, damaged membrane, freezing and/or extreme temperatures).

## Safety Information

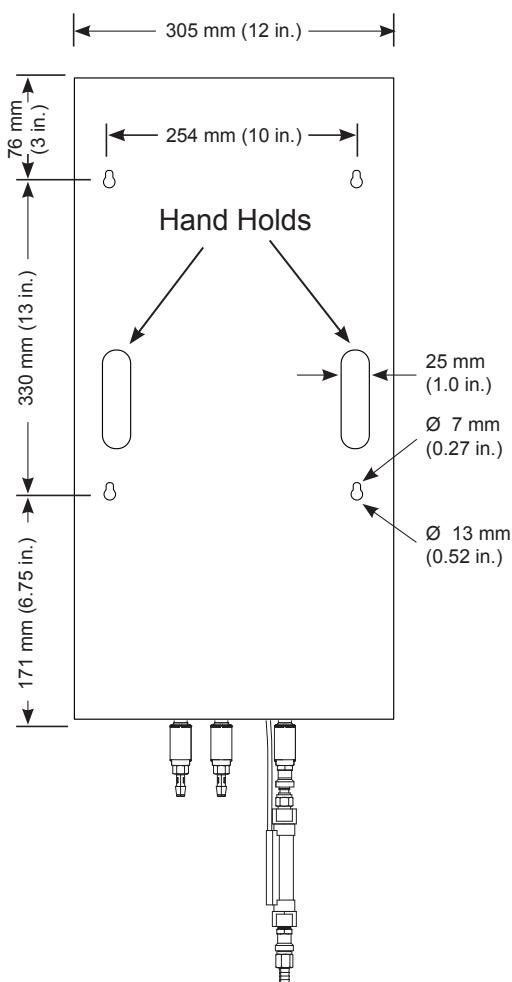
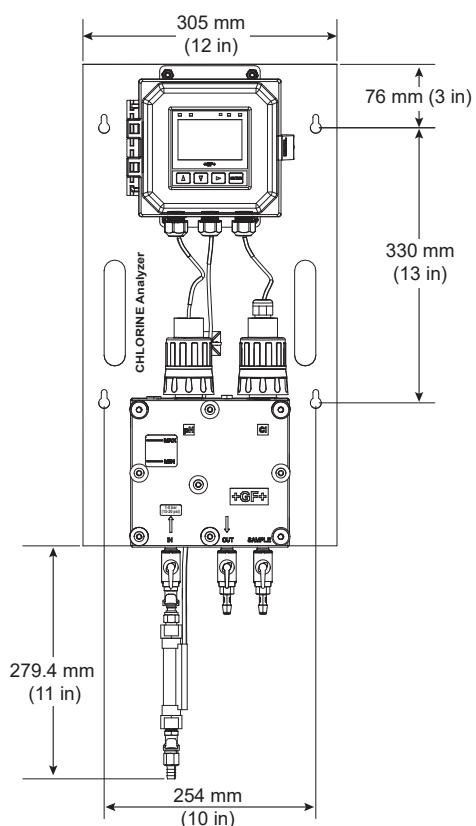
	<b>Caution / Warning / Danger</b> Indicates a potential hazard. Failure to follow all warnings may lead to equipment damage, injury, or death.
	<b>Electrocution Danger</b> Alerts user to risk of potential of injury or death via electrocution.
	<b>Electrostatic Discharge (ESD)</b> Alerts user to risk of potential damage to product by ESD.
	<b>Personal Protective Equipment (PPE)</b> Always utilize the most appropriate PPE during installation and service of GF products.
	<b>Pressurized System Warning</b> Sensor may be under pressure, take caution to vent system prior to installation or removal. Failure to do so may result in equipment damage and/or serious injury.
	<b>Hand Tighten Only</b> Overtightening may permanently damage product threads and lead to failure of the retaining nut.
	<b>Do Not Use Tools</b> Use of tool(s) may damage product beyond repair and potentially void product warranty.
	<b>Note / Technical Notes</b> Highlights additional information or detailed procedure.
	<b>Do Not Freeze</b> Products are temperature sensitive and may contain freezable liquids. Freezing damage to pH, ORP, and Chlorine electrodes voids product warranty.

\* NOTE: The 9950-X Chlorine Controller is **not** compatible with the standard 9950 controller

## Table of Contents

Description .....	1
Warranty Information.....	2
Safety Information.....	2
Chlorine System Dimensions / Specifications.....	3
Mounting / System Inventory .....	4
Quick Start .....	4
9950-X* Operation / Terminal Identification .....	5
Panel Assembly.....	6
Component Identification: Flow Cell .....	7
Wiring	
3-9950-X Input Power Wiring.....	8
3-9950-X 4 to 20 mA Wiring Loop 1 & 2.....	8
3-9950-X 4 to 20 mA Wiring Loop A & B.....	8
3-9950.393-3 Standard with 9950-X.....	9
3-9950.393-3 with internally powered flow switch .....	9
Sensor Wiring.....	9
Chlorine Sensor Preparation / Maintenance .....	10
Sensor Installation.....	11
Tubing Connections .....	12
Water Flow .....	12
9950-X Chlorine Controller	
Calibration .....	13-15
Signal Type: Digital (S <sup>3</sup> L) .....	16
Module Installation .....	16
Plug-In Modules .....	17
Loop and Modbus Modules .....	17
Relay Modes .....	18-21
Chemical Guard .....	19
Standard Relay Mode .....	20
Menu System	
View Mode Overview .....	22
Menu Mode Overview .....	22
Password Overview .....	22
View Mode .....	23-24
Calibration .....	25
Chlorine Electrode Calibration .....	25
pH Electrode Calibration.....	26
Input Menu .....	27-28
4 to 20 mA Output (Loop Output).....	29
Relay Menu	
Chemical Guard Menu .....	30-31
Standard Relay Menu .....	32
Option Menu.....	33-34
Modbus Menu .....	35-36
9950 Field Software Upgrade / Updating the 9950 .....	37
Troubleshooting .....	38-39
Calibration Error Messages .....	39
2630 Free Cl / 2632 ClO <sub>2</sub> Electrode .....	40-42
2724 DryLoc pH Electrode.....	43
pH System Calibration .....	44-45
Buffer Solutions .....	45
Electrode Storage .....	45
463X Chlorine Analyzer Flow Cell .....	46
O-ring Installation .....	47
Flow Cell Assembly .....	48
Troubleshooting	
463X Chlorine Analyzer .....	49
9950-X Chlorine Controller .....	50
9950-X Error Messages .....	51
2630 Free Cl / 2632 ClO <sub>2</sub> Electrodes .....	52
2751-7 pH Electronics.....	52
Specifications	
9950-X Chlorine Controller .....	53
2650 DryLoc® Amperometric Electronics.....	54
2751-7 pH Electronics.....	54
2630 Free Cl / 2632 ClO <sub>2</sub> Electrodes .....	55
2724 DryLoc® pH Electrode .....	56
Ordering Information .....	57-58

## Dimensions



## System Specifications

### General

Compatible GF Sensors  
 3-2630-1 Free Chlorine Sensor 0.02 to 2 ppm  
 3-2630-2 Free Chlorine Sensor 0.05 to 5 ppm  
 3-2630-3 Free Chlorine Sensor 0.1 to 20 ppm  
 3-2632-1 Chlorine Dioxide Electrode 0.02 to 2 ppm  
 3-2724-00 Flat pH Electrode

Free Chlorine ..... 5.5 to 8.2 pH  
 (consult factory for pH above 8.2)  
 Chlorine Dioxide ..... 4.0 to 11 pH

### Materials

Panel ..... Black acrylic  
 Flow Cell ..... Acrylic  
 Wiring Enclosure ..... Polycarbonate  
 Wetted Materials  
 Flow cell, spacer rings ..... Acrylic  
 Flow regulator housing ..... Polycarbonate  
 Strainer, e-clip, regulator  
 spring, float ..... Stainless steel  
 Valves, vent ..... Polypropylene  
 Flow Cell O-rings,  
 diaphragm ..... EPR (EPDM), FKM  
 Chlorine electrode ..... PVC, PTFE, FKM, Nylon, Silicone  
 pH electrode ..... PPS, Glass, UHMWPE, FKM  
 Sealing tape  
 (valves, plug, vent) ..... PTFE  
 Plug ..... Polyethylene  
 Flow Switch ..... Polypropylene

### Performance

System Inlet  
 Pressure Rating ..... 1 to 8 bar (15 to 120 psi)  
 Pressure Regulator ..... < 0.69 bar (10 psi) variation over  
 all ranges of flow and pressure  
 Flow tolerance ..... ±15% or rated specification above  
 Flow rate limits ..... 8 to 12 gph (US)  
 (30.24 to 45.36 LPH)

### Power Requirements

3-9950-3 ..... 24 VDC nominal  
 (12 to 32 VDC, ± 10% regulated)  
 UL 60950-1 or UL 61010-1  
 3-9950-4 ..... 100 -240 VAC at 50-60 Hz,  
 24 VA max.  
 3-9950-X Relay Mode ..... Current draw up to 500 mA  
 Current Loop ..... 12 to 32 VDC, ± 10% regulated,  
 4 to 20 mA (30 mA max.)  
 Overvoltage Protection ..... 48 Volt Transient Protection Device.  
 Current limiting for circuit protection.  
 Reverse-voltage protection.

### Environmental Requirements

Storage Temperature ..... 0 °C to 65 °C (32 °F to 149 °F)  
 Operating Temperature ..... 5 °C to 45 °C (41 °F to 113 °F)  
 Relative Humidity ..... 0 to 95%  
 Maximum Altitude ..... 4000 m (13,123 ft)  
 Shipping Weight ..... 10 kg (22 lbs)  
 Enclosure ..... NEMA 4X (with output wire  
 glands sealed)

### Standards and Approvals

CE, UL, CUL, WEEE  
 RoHS Compliant  
 Manufactured under ISO 9001, ISO 14001 and ISO 45001.  
 China RoHS (Go to [www.gfps.com](http://www.gfps.com) for details)

### Declaration of Conformity according to FCC Part 15

This device complies with Part 15 of the FCC rules.

Operation is subject to the following two conditions:  
 (1) This device may not cause harmful interference, and,  
 (2) This device must accept any interference received,  
 including interference that may cause undesired operation.

Safety Data Sheets (SDS) are available online at [www.gfps.com](http://www.gfps.com).

## Mounting



### Do not mount in direct sunlight.

- Bright light can promote algae growth. Indoor mounting is recommended.
- If the system is mounted outdoors, an outdoor enclosure for the whole system must be used to protect the electronics and flow cell from light, rodents, insects and dirt.
- Mount the panel according to local electrical, building, and/or plumbing codes and seismic requirements.
- Use four 6 mm (1/4 in.) diameter screws or bolts of sufficient length to mount the panel to a sturdy vertical surface. A mounting template is provided.
- Allow clearance on the sides and bottom for service to the unit.
- Keep panel system electronics and enclosure away from dripping water.
- The panel must be mounted vertically in an upright position.

## System Inventory

1. Chlorine panel assembly
  - a. Built-in pressure regulator 15 to 120 psi.
  - b. 3/8 inch hose barb connectors.
  - c. Flow switch
2. 1 each 2630 series Free Chlorine sensor or 2632 Chlorine Dioxide sensor; each with protective cap
  - a. 1 spare membrane cap
  - b. 2 bottles of electrolyte solution
  - c. 1 syringe needle (taped to bottle)
  - d. 1 syringe
3. 1 each Flat pH sensor 3-2724-00 (159 001 545) (pH sensor is available in ALL models except the 3-4630-12)
4. Manual package
  - a. English and Chinese panel assembly manuals
  - b. Wall mounting hardware
  - c. Drill template
5. Customer supplied
  - a. 3/8" hose input and drain
  - b. Hose clamps

## Quick Start

Follow the steps below to set up a new Chlorine Analyzer System. Refer to the individual component manuals for detailed information.

**Step 1.** Mount the panel on a vertical flat surface using appropriate hardware.



### Do not turn on power at this time.

**Step 2.** Open the wiring enclosure and remove foam shipping block, dispose of block.

**Step 3.** Wire input power.

(see page 8: Wiring Input)

**Step 4.** Remove sensor access plugs from the flow cell, see page 7.

If the optional pH sensor is NOT used, do not remove the left-side plug from the flow cell.

**Step 5.** Remove the protective cap from the chlorine electrode.

(Keep the electrode cap in a safe place for future use. It is recommended to use the cap to protect the sensor during the removal of the electrode for cleaning or maintenance of the flow cell)

**Step 6.** **Complete Sensor Preparation** (see page 10) and install the chlorine sensor into the electronics.

(see page 11: Sensor Installation) Install the chlorine electrode into the flow cell.

The chlorine sensor is installed in the right-side access port, optional pH sensor is installed in the left-side access port.

**NOTE:** Both the Chlorine and the pH electrodes are required to be calibrated for accuracy. Upon initial set up the electrodes will need to be placed in a chlorinated flow stream for a minimum of 4 hours in a conditioning period. Calibration of the Chlorine electrode is typically required every 14 to 21 days to comply with the EPA standard 334.0. The calibration frequency of the pH electrode is application dependent and the intervals between calibrations must be determined by the user of the system. See page 10: Chlorine Sensor Calibration, for chlorine calibration and set up procedure.

**Step 7.** Repeat step 5 and 6 for the pH electrode.

**Step 8.** Remove the flow switch from the bottom of the flow cell and install into the flow cell, see page 7

**Step 9.** Install the influent water source to the "Inlet Port" nipple assembly of the flow switch. Install 3/8-inch tubing and secure with a hose clamp.

(Not included. See page 12: Tubing Connections)

**Step 10.** Install 3/8-inch tubing and secure with a hose clamp on the "Drain" port and direct the tube to a proper drain.

(Not included)

**NOTE:** Drain line (zero pressure) must be lower than influent line to prevent back flow into the flow cell.

**Step 11.** Verify the inlet and drain ball valves are in the open position and the sample port is in the off position.

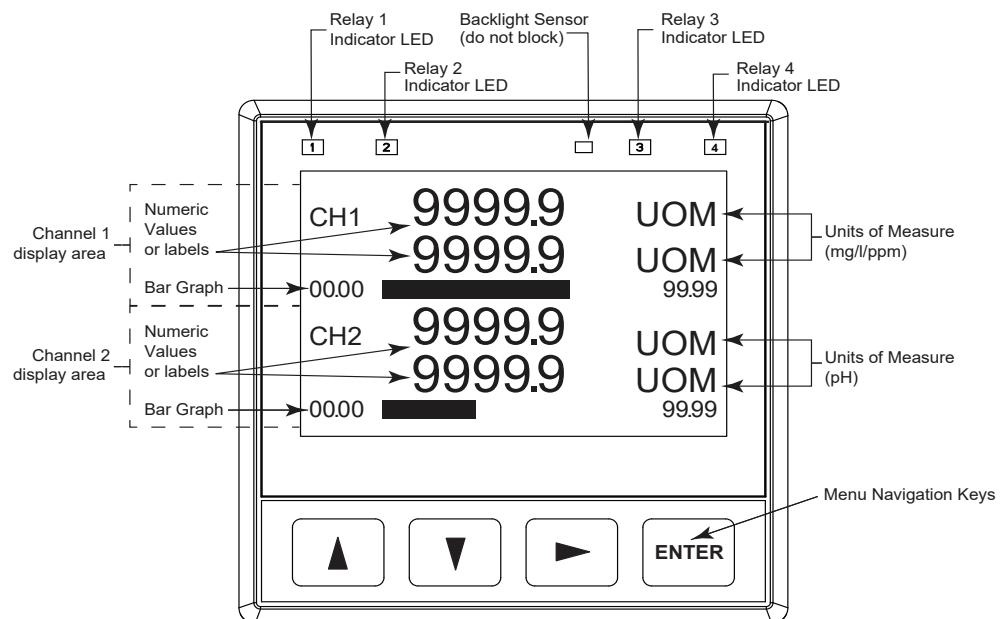
(See page 12: Tubing Connections)

**Step 12.** Turn on the influent water source and check the system for leaks.

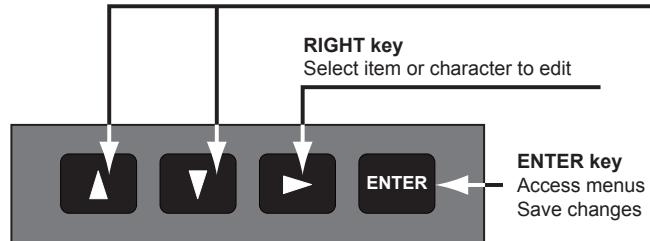
**Step 13.** Apply power to the system and allow system to initialize. Calibrate per instructions.

(See page 10: Chlorine Sensor Calibration)

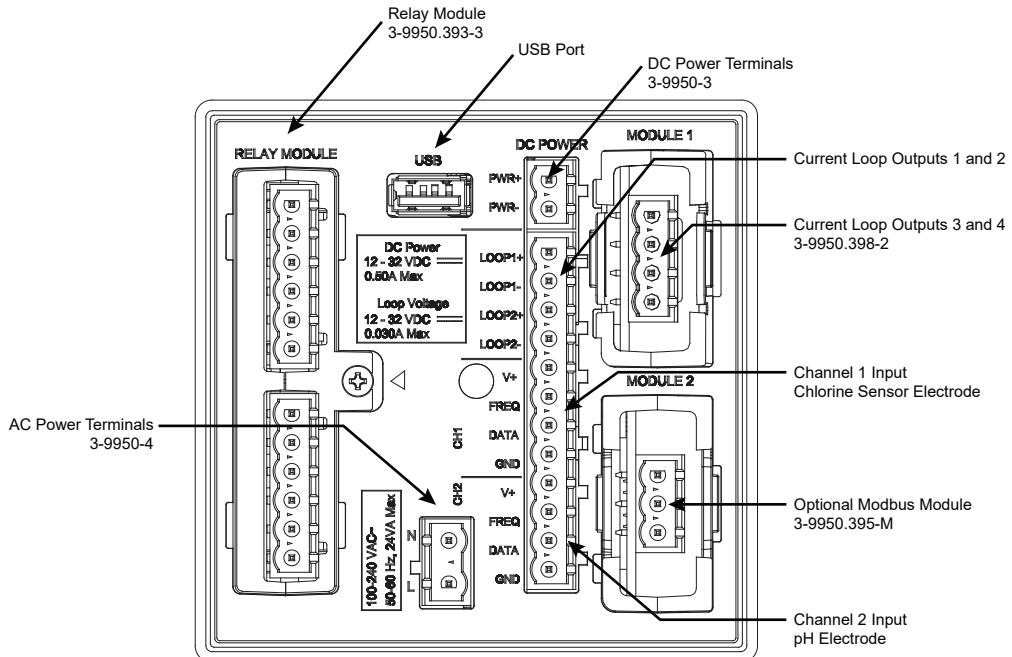
## 9950-X Operation



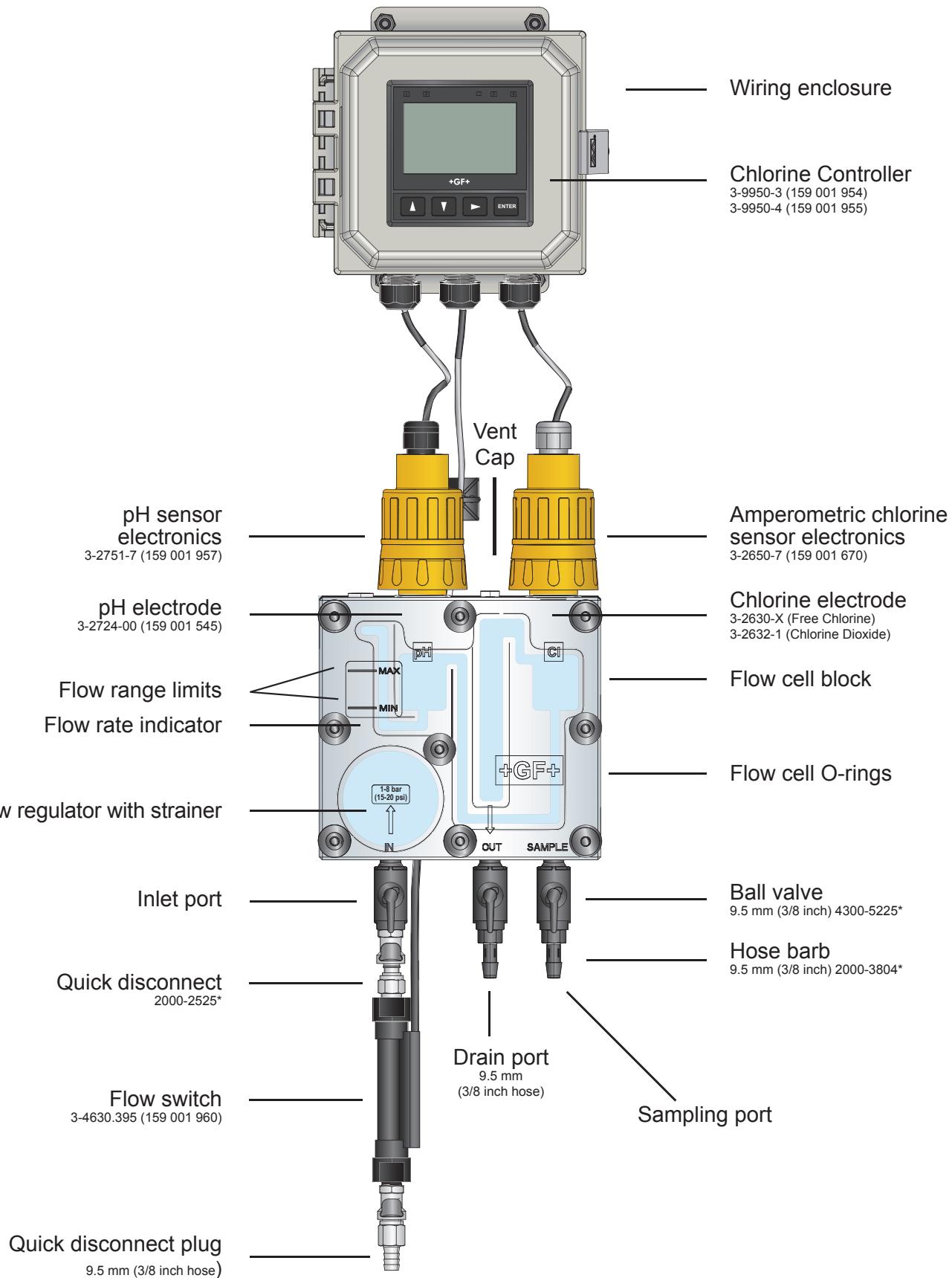
UP, DOWN keys  
Scroll through Menu options or adjust values during editing  
Press both together to exit a menu or escape without saving



## 9950-X Terminal Identification

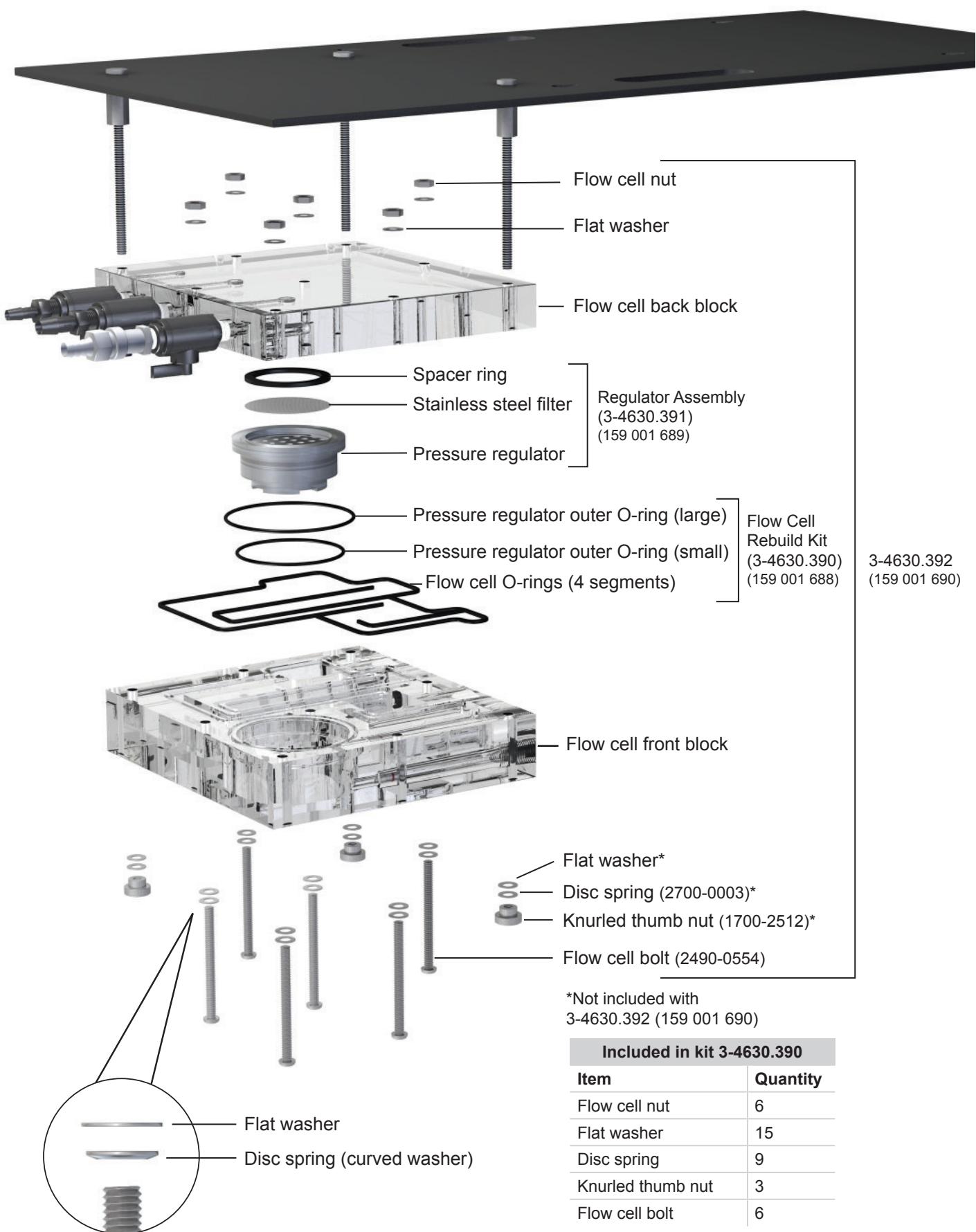


## Panel Assembly



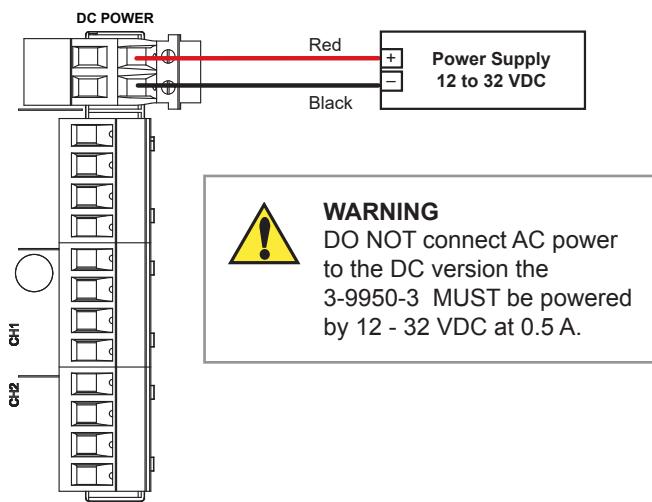
\* Contact factory for quote

## Component Identification: Flow Cell



## Wiring

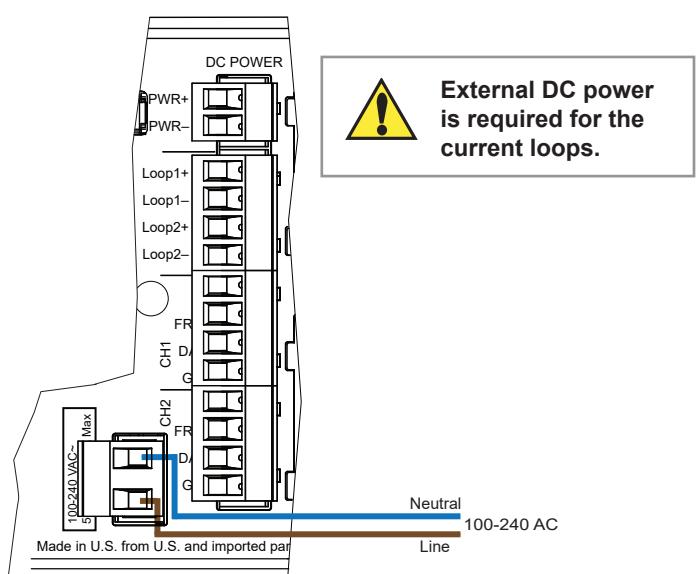
### 3-9950-3 DC Input Power Wiring



#### CAUTION:

For DC power input and loop current regulated voltage, use UL60950-1 or UL61010-1 certified power supply. Power supply shall also be rated for operation at 4000 m altitude.

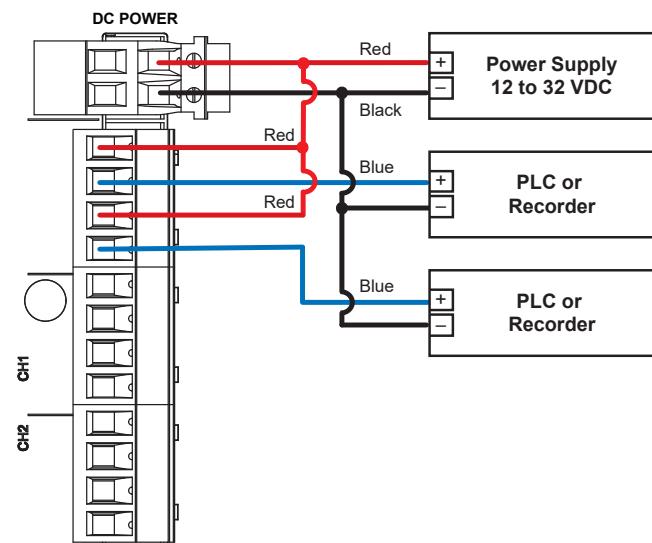
### 3-9950-4 AC Input Power Wiring



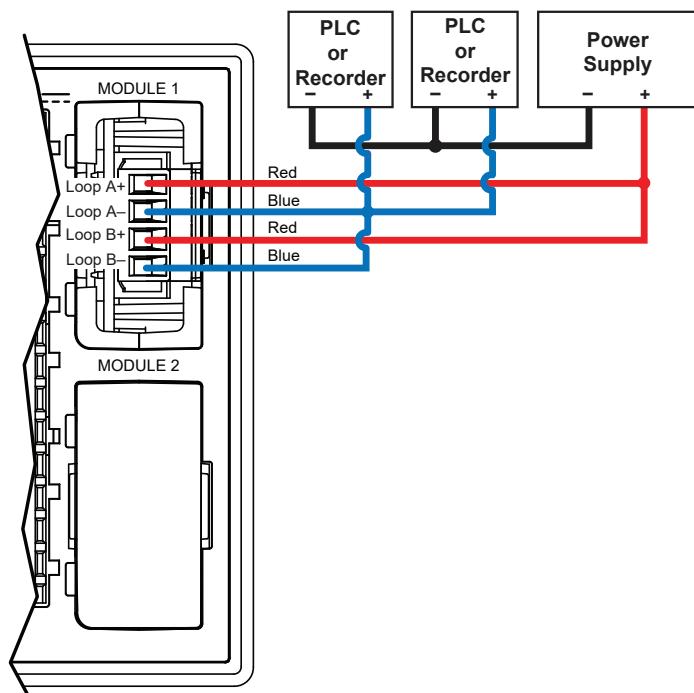
#### CAUTION:

Keep AC power separate from sensor and signal wiring to prevent interference and damage to the 9950-X Chlorine Controller.

### 3-9950-X 4 to 20 mA Wiring Loop 1 & 2



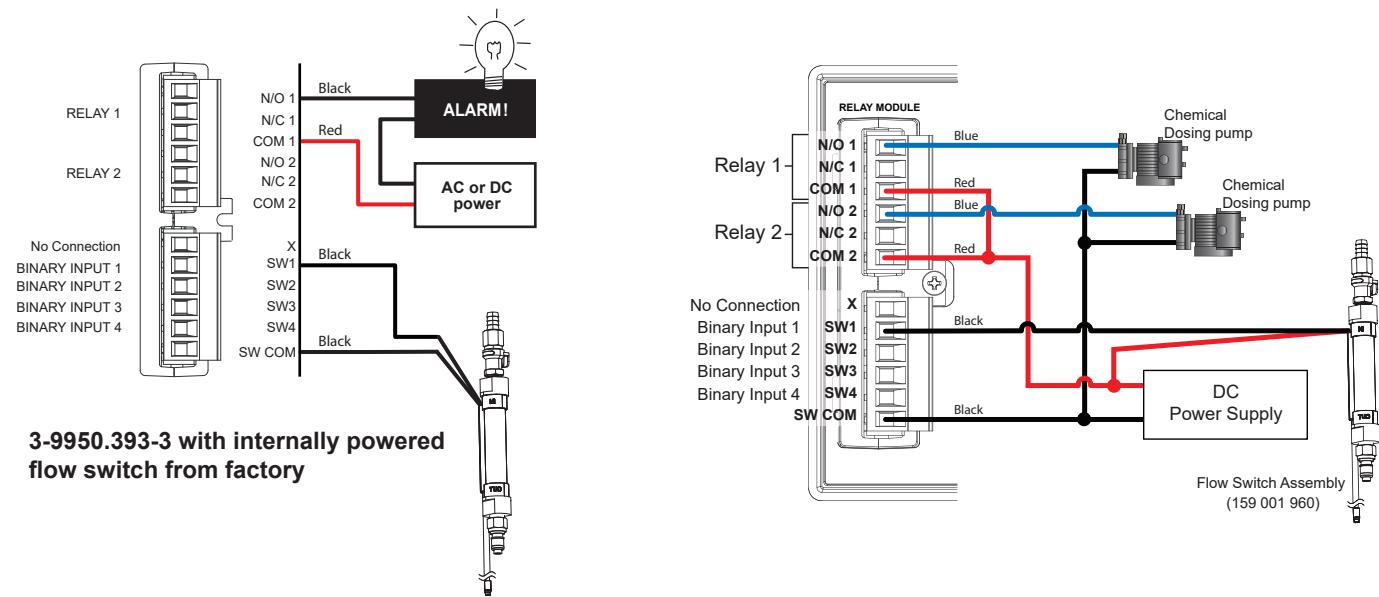
### 3-9950-X 4 to 20 mA Wiring Loop A & B



## Wiring continued

### 3-9950.393-3 Standard with 9950-X

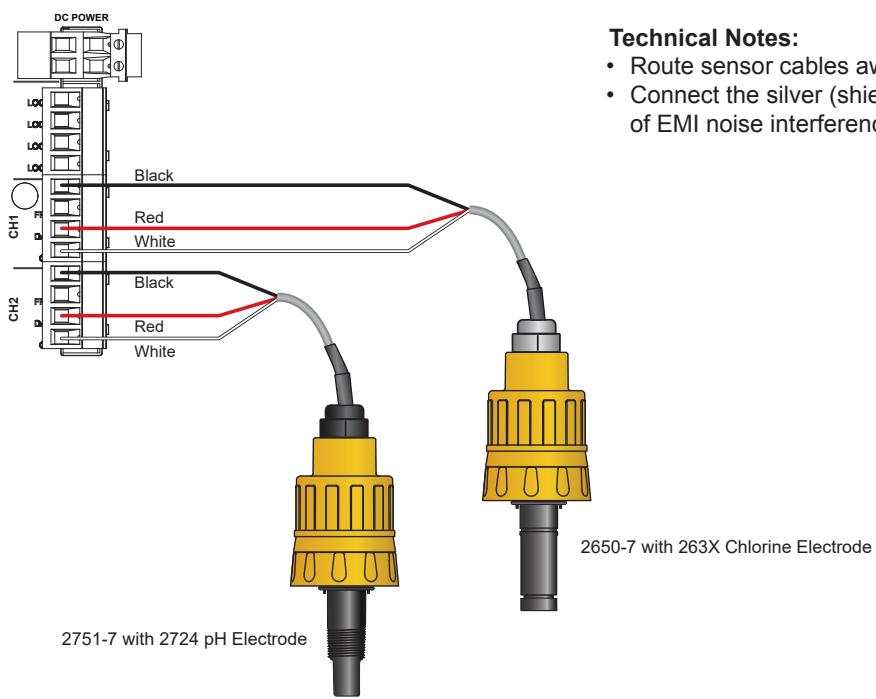
The alarm is OFF during normal operation, and will go ON when the relay energizes according to 9950-X Relay settings.



**NOTE:** Default wiring for production units after February 2022

**NOTE:** Default wiring for production units prior to February 2022

## Sensor Wiring



### Technical Notes:

- Route sensor cables away from AC power lines.
- Connect the silver (shield) wire to earth ground in case of EMI noise interference.

## Chlorine Sensor Preparation

### 2630 Free Chlorine Electrode

### 2632 Chlorine Dioxide Electrode

**NOTE:** See page 40 for additional 2630, 2632 information.

- Chlorine sensors are shipped without internal electrolyte solution.
- Prior to installation and supplying power, Chlorine sensors must be filled with the appropriate internal electrolyte solution.
- Verify the correct electrolyte solution is utilized with the corresponding sensor.
- Free Chlorine and Chlorine Dioxide sensors require different electrolyte solutions.



**Avoid skin or eye contact with electrolyte solution.**

**Wear rubber gloves and goggles.**

\*Safety Data Sheets (SDS) are available online at [www.gfps.com](http://www.gfps.com).

**CAUTION!** DO NOT touch the gold tip or the membrane of the sensor.

#### Initial Fill Procedure:

When adding electrolyte, be prepared for an accidental spill.

Working near a sink is recommended.

1. Remove the protective bottle from the end of the electrode.
2. Remove the membrane cap from the front of the sensor.
- Note:** When new sensors are shipped, the membrane cap is not tightened to the sensor.
3. Fill supplied syringe with electrolyte solution.  
Additional caution should be taken when handling Chlorine Dioxide electrolyte solution.
4. Place the electrode on a level surface.
5. Insert syringe needle fully into one of the eight electrode holes while injecting with electrolyte solution. Slowly injecting the electrolyte solution into the sensor to avoid introducing air bubbles. The electrode holds approximately 14 milliliters of solution. Slowly fill until solution begins to flow out of holes. Do not allow the solution to run down the electrode and wet the electrical contacts in the DryLoc connector.
6. Slowly screw on the membrane cap finger tight. Do not use tools. To avoid damage and contamination, do not touch the white membrane surface on the membrane cap.

## Chlorine Sensor Calibration

A new chlorine electrode or one that has had the membrane cap changed must be calibrated. See page 13, 9950-X information on calibration of the chlorine sensor. A diethyl-p-phenylenediamine (DPD) colorimeter test kit (not included) is required for sensor calibration. A sample is taken and analyzed with the DPD test kit, then this value is entered into the 9950-X.

- A new system requires an initial 4 hour conditioning.
- Calibrate after a membrane cap change (requires 2 hour stabilization time).
- Calibrate after the internal electrolyte is replaced (requires 2 hour stabilization time).
- Check calibration 24 hours after sensor is placed in service.
- Check calibration weekly to monthly depending on process requirements.

## Chlorine Sensor Maintenance

The sensor membrane and internal electrolyte solution must be replaced over the life of the electrode. To maintain accurate chlorine measurements, GF recommends that the internal electrolyte be replaced every 3 to 6 months, or when Chlorine readings drift low and/or cannot maintain a calibration longer than 5 days. Actual interval between maintenance of the sensor will be dependent on the application, chlorine level and contaminates in the water. See page 41; Maintenance and Storage.

Keep spare membrane caps available. Membrane caps carry no warranty.

To maintain accurate chlorine measurements, GF recommends the internal electrolyte be replaced and the gold-plated sensor electrode be properly polished every 3 to 6 months. See page 41.



#### CAUTION:

DO NOT touch the gold-plated tip or the membrane of the sensor.

## Sensor Installation

- Remove sensor access plugs from the flow cell.
- Note: Chlorine Sensor Preparation must be completed prior to installation, see 10.**
- Holding the 3-2751-7 (159 001 957) or 3-2650-7 (159 001 670) electronics inverted, open the DryLoc® connector by turning the upper locking ring  $\frac{1}{4}$ -turn counter-clockwise.
- Insert the electrode facing up. Turn the locking ring  $\frac{1}{4}$ -turn clockwise to lock the electronics in place.
- The mechanism will “click” when it is locked.
- Install the complete electrode assembly into the flow cell and ensure the key on the electrode aligns with the key slot on the flow cell.



**Avoid skin or eye contact with electrolyte solution.**

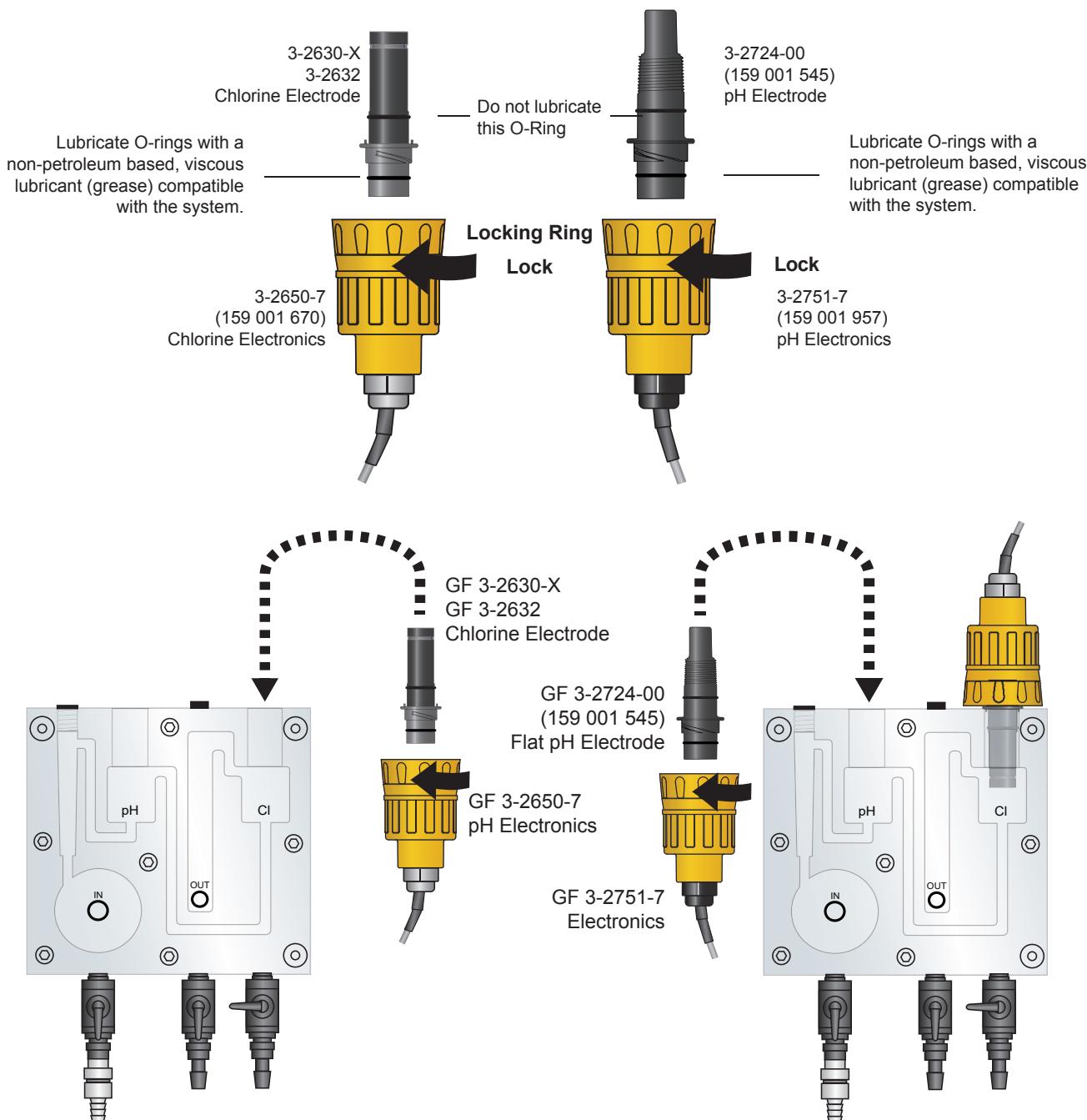
**Wear rubber gloves and goggles.** Safety Data

Sheets (SDS) are available online at  
[www.gfps.com](http://www.gfps.com).



**Lubricate the DryLoc® O-ring only.**  
**Do not lubricate the sensors body O-ring.**  
**Turn by hand. Do Not Use Tools.**  
**Do Not Drop or Strike the Membrane.**

### DryLoc® Connection to Sensor Electronics

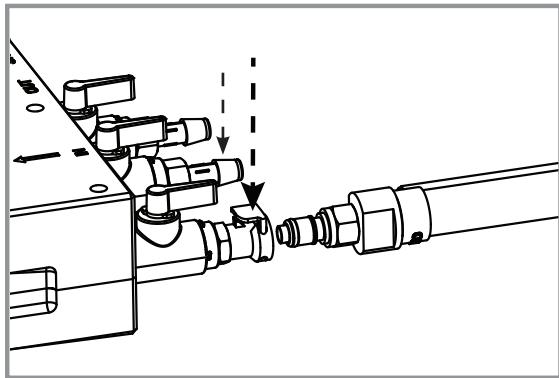


## Flow Switch and Tubing Connections

- Use suitable 9.5 mm (3/8 in) ID tubing that is rated for your inlet pressure.
- Use hose clamps.
- Remove the Flow Switch from the three ball valves located on the bottom of the flow cell.
- Insert inlet quick connect into the mating connector on the flow cell.

### Inlet Quick Release Connection

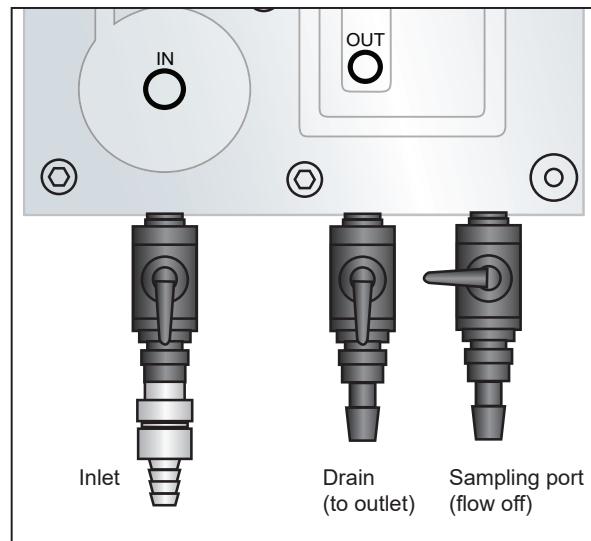
Press down gray plunger to release. Water flow is automatically shut off when disconnected.



### Valve position for start up and normal use.

**Note:** Turn off inlet valve first when stopping water flow.

- The drain tube must be positioned lower than the influent water source to allow proper flow through the flow cell. The flow cell must drain by gravity, not system pressure.
- When testing, allow the sample to flow for a few seconds before collection.

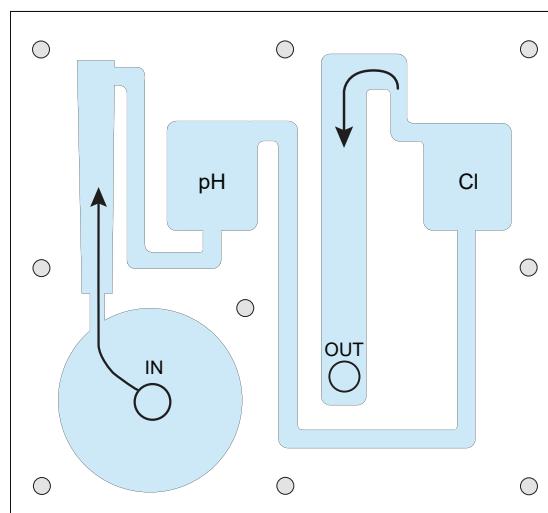
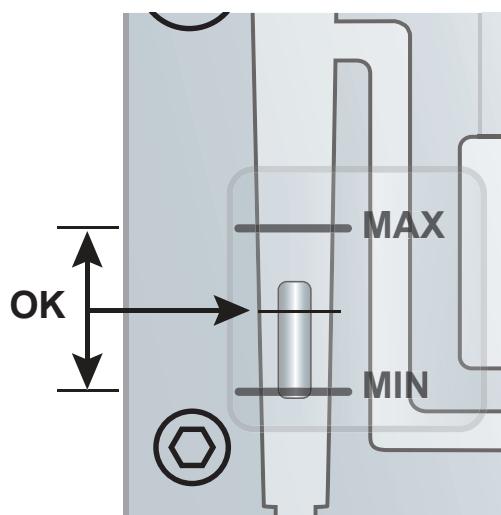


## Water Flow

### Flow Rate

The flow rate is in the proper range when the float is between the Min. and Max. markers on the flow cell. The flow range limits are 30.24 to 45.36 L/h (8 to 12 gal/h).

For Low Flow applications (flow less than 1 bar/15 psi), the Flow Regulator can be removed and the flow adjusted using the Flow Cell ball valve. **NOTE:** The inlet hose barb will also need to be changed. (Contact factory for details.)



## 9950-X Calibration

Both the Chlorine and the pH electrodes are required to be calibrated for accuracy. Upon initial set up the electrodes will need to be placed in a chlorinated flow stream for a minimum of 4 hours in a conditioning period. Calibration of the Chlorine electrode is typically required every 14 to 21 days to comply with the EPA standard 334.0. The calibration frequency of the pH electrode is application dependent and the intervals between calibrations must be determined by the user of the system.

In order to achieve the most accurate chlorine measurement, after the minimum 4 hour conditioning period, calibration must be performed in the following specific order:

- Temperature
- pH electrode (Free Chlorine only)
- Chlorine electrode

**NOTE:** The Temperature element only requires calibration one time during initial commissioning. Once calibrated the Temperature element is calibrated for the life of the chlorine electrode.

### Chlorine sensor temperature element calibration

The temperature element inside the chlorine sensor needs to be calibrated. Use a reference thermometer to verify the actual temperature of the sample. This value is then entered into the calibration screen of the Temperature Calibration menu.

**Tip:** Remove the pH electrode from the flow cell and insert the reference thermometer. If no pH sensor is being used ( $\text{ClO}_2$  system), remove the cell plug to insert the thermometer. Replace the plug after calibration.

### pH electrode calibration

It is highly recommended to perform a two point calibration of the pH electrode using a pH buffer 7 and pH buffer 4 or 10. The pH buffers' temperatures should be close to the system water temperature for an accurate calibration. Once a successful calibration is performed, the 9950-X will automatically time stamp the "Last CAL" display with the date of calibration. The user can add a date to the "NEXT CAL" display which will generate a "Calibration Due" icon across the pH channel (CH2).

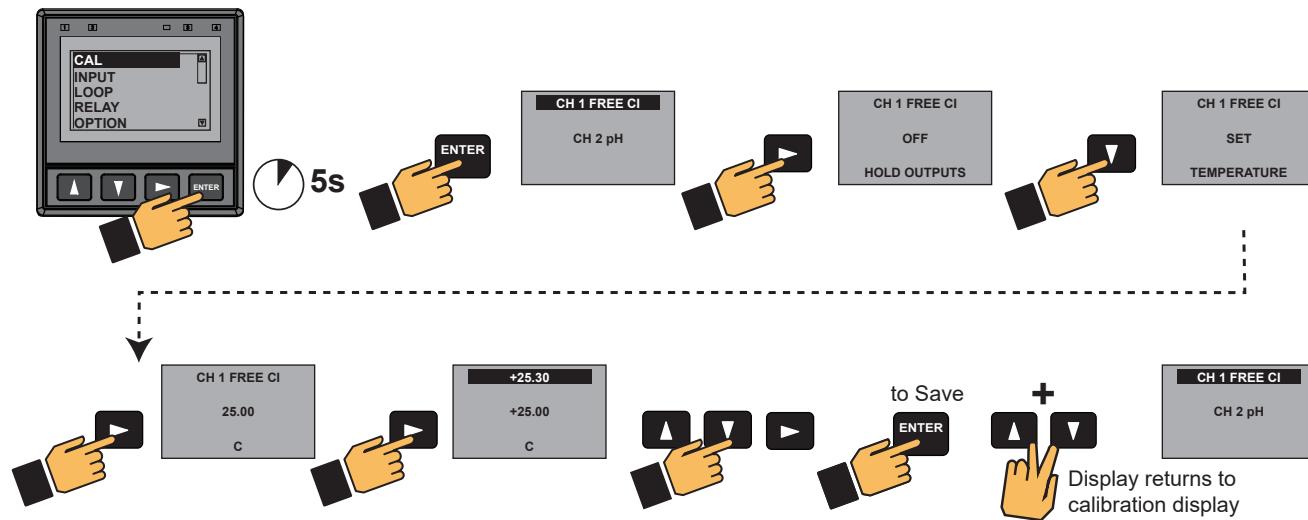
### Chlorine sensor

Calibration must be performed to every new chlorine sensor (FCI or  $\text{ClO}_2$ ) and any time a membrane cap or internal electrolyte is replaced. With the chlorine sensor attached to the 2650 electronics (with system power on) and placed in a chlorinated flow stream for the minimum of 4 hour conditioning period, the temperature and chlorine In-Process Calibration needs to be performed.

Once a successful calibration is performed the 9950-X will automatically time stamp the "Last CAL" display with the date of calibration. The user can add a date to the "NEXT CAL" display which will generate a "Calibration Due" icon across the chlorine channel (CH1).

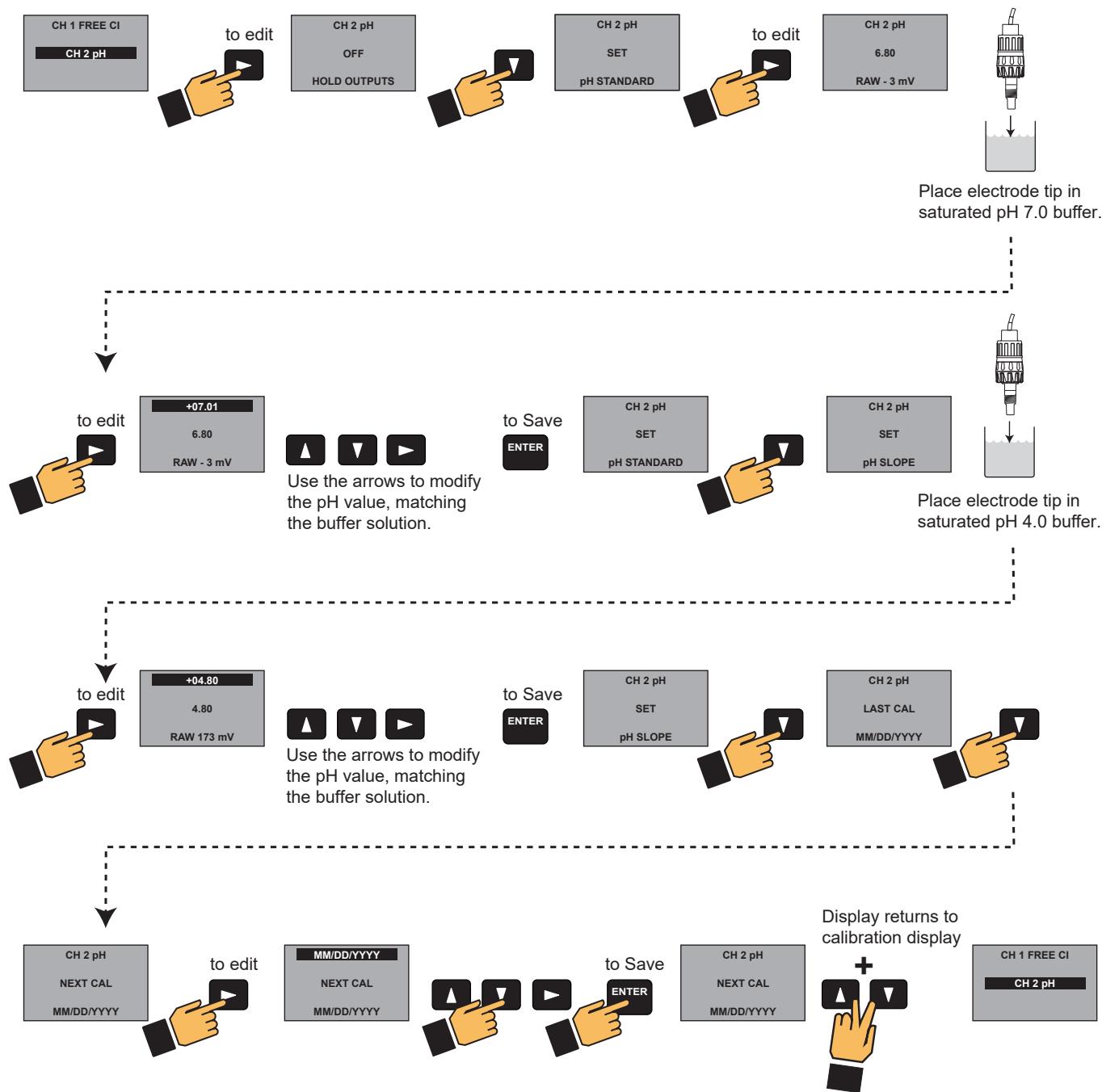
**NOTE:** It is advised to return 24 hours after the initial Chlorine calibration to verify and recalibrate if necessary.

### Temperature Calibration



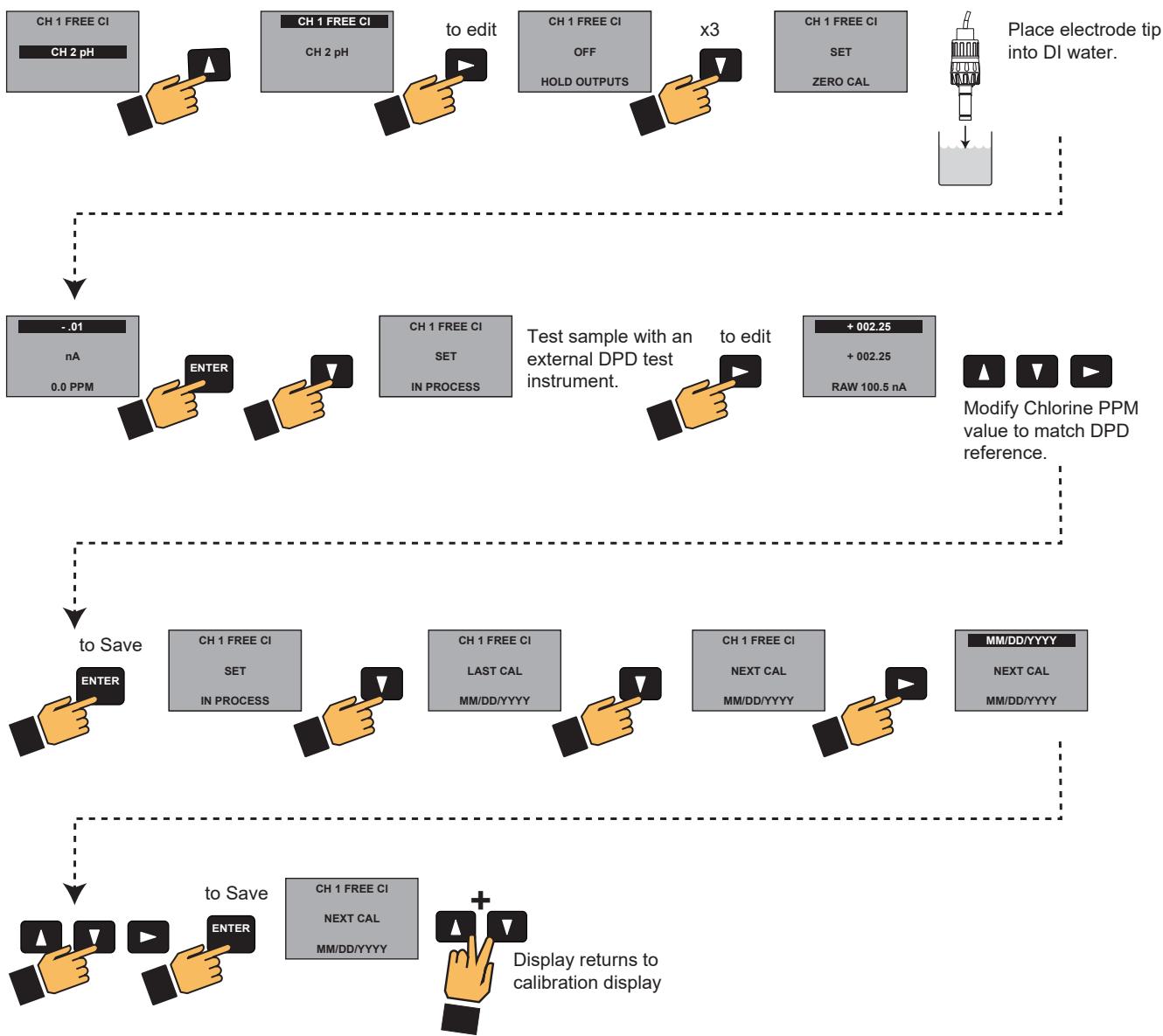
## Calibration

### pH Electrode Calibration



## Calibration

### Chlorine Electrode Calibration



## Signal Type: Digital (S<sup>3</sup>L)

- The input terminals on the 9950-X carry Digital (S<sup>3</sup>L) serial data from the sensor.
- Do not route sensor or output cables in conduit containing AC power wiring. Electrical noise may interfere with sensor signal.
- Routing cable in grounded metal conduit will help prevent electrical noise and mechanical damage.
- Seal cable entry points to prevent moisture damage.
- Only one wire should be inserted into a terminal. Splice double wires outside the terminal.
- The TOTAL cable length from I/O devices to the Chlorine Controller must not exceed 305 m (1000 ft).
- In case of noise interference, ground the sensor SHIELD wire to a local earth ground at a point near the sensor.
- Consult the sensor manual for additional wiring information.
- The maximum cable length of the Digital (S<sup>3</sup>L) bus varies depending on the types of sensors connected and the size of the conductors in the cable. For best results, determine the maximum cable length for the system before routing cables.

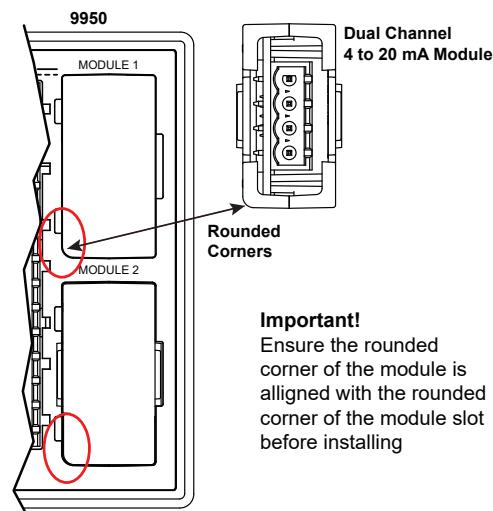
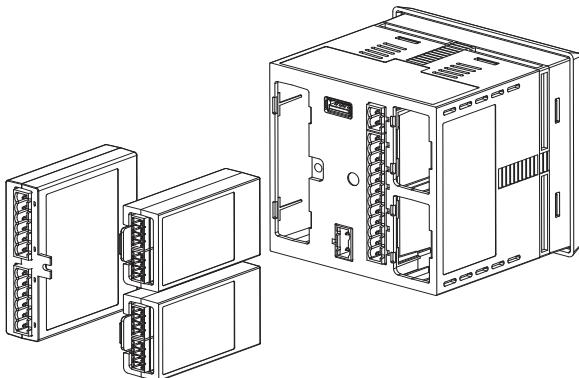


In case of noise interference, connect the cable shield to earth ground.

### Maximum total cable length of the Digital (S<sup>3</sup>L) Bus:

The quality of the cable used in the bus determines the maximum length. The maximum cable length may not exceed 305 m (1,000 ft), regardless of current requirements.

## Module Installation



**Important!**  
Ensure the rounded corner of the module is aligned with the rounded corner of the module slot before installing



### CAUTION

Avoid Electrostatic Discharge (ESD).

The plug-in modules may be installed either before or after the base unit is mounted. If the 9950-X Base Unit will be mounted using the provided quick clip mounting bracket, install plug-in modules first with power disconnected.



### CAUTION

Exercise care when installing modules.  
Do not bend connecting pins.

#### To install modules:

Remove power from the 9950-X. Carefully align pins and connectors (do not bend connecting pins) and push module firmly into place, then attach with screw(s) for Relay Modules only.

#### To move modules:

Remove power from the 9950-X.

#### For Relay Modules:

Unplug connectors, remove screw(s), and carefully pull module straight out from the base unit. Do not bend the connecting pins.

#### For Dual Channel 4 to 20 mA, and Modbus Modules:

Unplug connectors and squeeze the two retaining tabs while pulling module out of 9950-X.



### WARNING

Relays may be connected to external high-voltage power sources or multiple power sources creating an electrocution hazard.

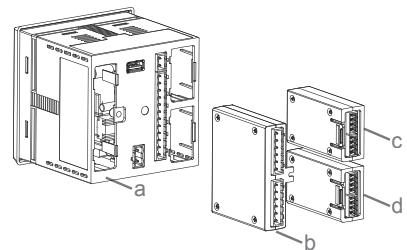
## Plug-In Modules

Standard modules for the 9950-X:

- a. Base Unit (required)
  - 1. 3-9950-3 159 001 841 Base Controller, DC power
  - 2. 3-9950-4 159 001 955 Base Controller, AC power
- b. Relay Module 3-9950.393-3 159 310 270 Relay Module
- c. 4 to 20 mA Module 3-9950.398-2 159 001 848 Dual Channel 4 to 20 mA Output Module

Optional module for the 9950-X:

- d. Module 2 3-9950.395-M 159 001 905 Modbus Module (optional)



Each item is ordered separately. Modules are field-replaceable at any time.

See Module Installation (pg. 11) and Ordering Information (pg. 68) sections for more details.



### CAUTION

Avoid Electrostatic Discharge (ESD).

- Minimize handling of the plug-in modules to reduce the possibility of damage due to ESD.
- Handle modules by the edges.
- Never touch any exposed circuitry or contacts.
- Wear an anti-static wristband or stand on an anti-static mat, or keep one hand touching a properly grounded pipe or other piece of properly grounded metal when handling modules.

## Loop and Modbus Modules

Mfr. Part No.	Code	Description
3-9950.398-2	159 001 848	Dual Channel 4 to 20 mA Current Loop Output Module
3-9950.395-M	159 001 905	Modbus Module

### Dual Channel 4 to 20 mA Module

Two additional 4 to 20 mA passive current loop outputs in a single module, allows up to six current loop modules in the 9950-X Chlorine Controller.

### Modbus Module (Optional)

The Modbus Module connects the 9950-X to serial RS485 Modbus automation networks. The Modbus Module will allow for PLCs and SCADA Systems to query the current readings, channel status, state of the relay and 4 to 20 mA outputs, along with status of the 9950-X Chlorine Controller and Modbus communications.

Detail programming information is available in the 9950 Modbus Programming Manual, available at [www.gfps.com](http://www.gfps.com).

### Default Communication Parameters

ModBus Address	95
ModBus Termination	Off
ModBus Mode	RTU
ModBus Baud Rate	19.2K
ModBus Parity	Even
ModBus Endian	Big

## Relay Modes

The 9950-X has a slot for an optional Relay Module for the module listed on page 17.

- The four Binary Inputs can detect if an external switch is open or closed. The switch state can be used to enable or disable the relays in the module. The four binary inputs only control relay activation and are not considered an input measurement. This is standard on the 9950-X.
- A flow switch must be wired into Binary input #1 to allow access to the Chemical Guard mode of the 9950-X.
- Dry-contact relays are electromechanical switches with a moving contact armature. They are suitable for many general-purpose applications, AC or DC, including AC loads up to 250 V.

For wiring information, refer to the Relay Wiring section, page 8.

### Binary Input Ratings

Maximum Input voltage (without damage)	30 VDC
Minimum Input voltage (without damage)	-5 VDC (no operation below 0 VDC)
Maximum input voltage for signal "Off" (low or "0")	1.5 VDC
Minimum input voltage for signal "On" (high or "1")	3.0 VDC
Maximum current draw for signal "0" (low)	$\leq 500 \mu\text{ADC}$
Minimum current draw for signal "1" (high)	500 $\mu\text{A}$
Typical current draw for signal "1" (high)	6.0 mA at 30 VDC, 4.8 mA at 24 VDC, 2.4 mA at 12 VDC, 1.0 mA at 5 VDC



The 3-9950.393-3 module can be set to supply power to the external switch/sensor. If an externally powered sensor is connected with the 3-9950.393-3 module, set the power switch to the EXT position. The module can power external sensors by switching the power switch to the INT position. Maximum power that can be drawn from the module is 6mA at 30 VDC. Important for externally powered switches/sensors to ensure the output signal is within the allowable range for the 3-9950.393-3.

### NOTE:

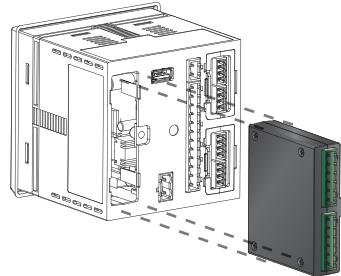
- The four red Indicator LEDs on the front panel of the 9950-X show the status of relays 1, 2, 3, & 4. The LEDs will activate with or without a relay module installed.
- Hysteresis and time delay are adjustable for each relay.

### CAUTION

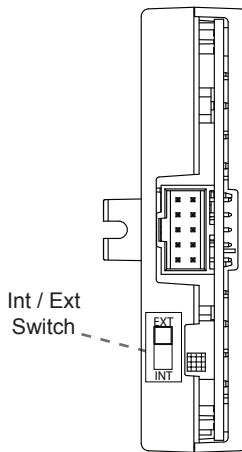


Switching active loads (usually inductive) can cause contact arcing sufficient to damage the relays.

The RC Filter Kit or "snubber" (part number 3-8050.396) is available as an accessory to reduce or eliminate these damaging effects. Recommended for inductive loads greater than 50 VAC (remote relays, solenoids, pumps, etc.)



3-9950.393-3



### CAUTION

Keep relay wiring separate from electrode and signal wiring to prevent interference and damage to the 9950-X Chlorine Controller.

## Relay Modes

### Chemical Guard

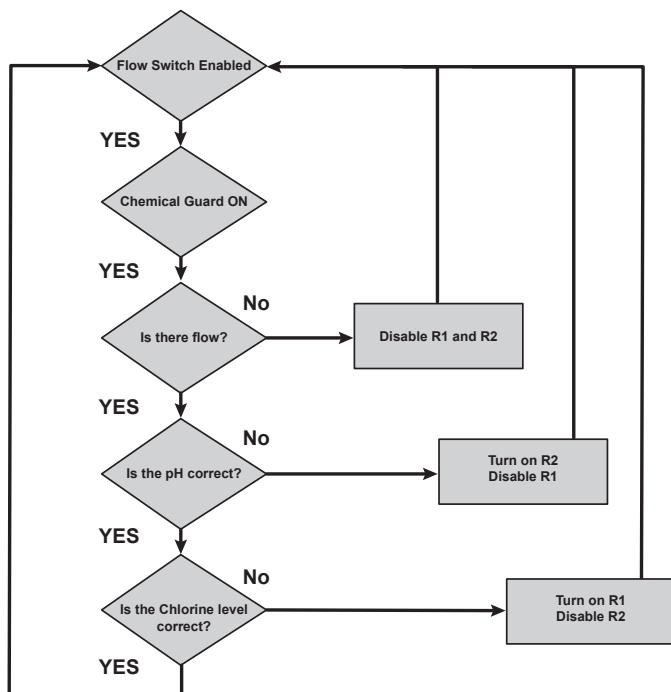
The Chemical Guard prevents overdosing of oxidant type chemicals (Chlorine) whose concentration varies based on the pH level of the application.

The Chemical Guard is only accessible in the relay menu when used in conjunction with a flow switch (GF option) that is wired to the Binary Input #1 of the 3-9950.393-3 relay module.

When the Chemical Guard function is selected, Relay 1 is automatically defaulted to control and adjust the Oxidant chemical (Chlorine) and Relay 2 is defaulted to control and adjust the pH level of the application.

The control logic (Fig #) will always interrupt (disable) Relay 1 if the pH requires adjusting. Once the pH is corrected, Relay 1 is then available to add additional oxidants to the application.

The Chemical Guard allows Relay 1 and Relay 2 to be independently programmed as a low set point, high set point or a proportional pulse output.



1. Press and hold ENTER for 3 seconds
2. Go to the Relay Menu by pressing ▼ ▼ ▼ then ENTER
3. Display shows "FLOW SWITCH" NO, press ▶ and change to YES, Press ENTER to save
4. Press ▼ screen should show "RELAY CHEMICAL GUARD" OFF
5. Press ▶ and change to YES, press ENTER to save
6. Press ▼ screen should show "Oxidizer" Mode OFF
7. Press ▶ and select LOW
8. Press ▼ x2 to set POINT DISPLAY
9. Press ▶ to enter the LOW SET POINT value 3.0 ppm, press ENTER to save
10. Press ▼ then press ▶ to enter ON DELAY time of 15 seconds, press ENTER to save
11. Press ▼ then press ▶ to enter an OXIDIER HYSTERESIS of 1.0 ppm, Press ENTER to save
12. Press ▼ x3 screen should show pH ADJUST Mode OFF
13. Press ▶ to change the Mode to HIGH
14. Press ▼ x2 then press ▶ to enter HIGH SET POINT of 7.5
15. Press ▼ then press ▶ to enter ON DELAY time of 15 seconds, press ENTER to save
16. Press ▼ then press ▶ to enter pH ADJUST HYSTERESIS of 0.3 ppm
17. Press ▲+▼ at the same time to go back to the VIEW Mode



Example: Maintain a pool's chemistry using two dosing pumps at pH 7.2 and chlorine at 3.0 ppm

## Standard Relay Mode

Set your relay functions to your own application requirements.

**Once a setting is saved it becomes immediately active.**

1. Press and hold ENTER for 3 seconds
2. Go to the Relay Menu by pressing ▼ ▼ ▼ then ENTER
3. Press the ► to select desired source. You will be asked to enter a code or password. Select source and press ENTER to confirm
4. Press ▼ to enter the relay **MODE** selection screen
5. Press ► and then ▼ to select **R1 MODE LOW**. Press ENTER to confirm
6. Press ▼ to **R1 SET LOW**. Press ► to enter PPM value of 2.0
7. Use the ▲ and ▼ to change Setpoint. Press ENTER to save
8. Scroll ▼ to the **R1 HYSTERESIS** menu
9. Press ► to edit
10. Set the hysteresis for this relay. Set the value to **1.0 ppm**
11. Press ENTER
12. Scroll down ▼ to the **R1 ON DELAY** menu
13. Press ► to edit
14. Set the turn-on delay in seconds for the relay: **15.0**
15. Press ENTER Then
16. Exit to View Mode **▲▼ ▲▼**

- Relay function can be tested in the RELAY menu



Example: Set a relay R1 to turn on at a low setpoint of 2.0 ppm with a time delay of 15 seconds and turn off at 3.0 ppm.

Remember,  
SET LOW + hysteresis = OFF  
Relay 1 Source = CH1 Primary  
Relay 1 Mode = Low  
R1 Set Low = 2.0  
R1 Hysteresis = 1.0  
R1 on delay = 15.0 sec

## Relay Modes

### • Binary

When the relay source is set to "Binary", the Binary Inputs can sense if the input is ON (Closed) or OFF (Open). The four binary inputs only control relay activation and are not considered a measurement source. Each binary mode is independent and each of them can be assigned to a relay mode.

### • Error Mode

Relay activated when any related failures occur for the system.

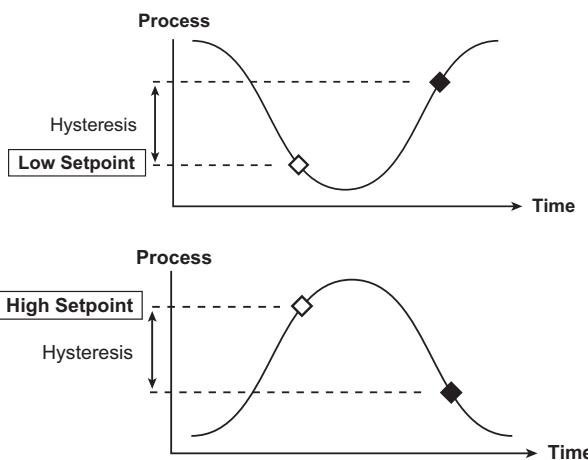
### Example: Binary Input

A 3-4630.395 Flow Switch is mounted in the Chlorine flow cell. The flow switch will prevent the relay(s) from activating if the flow to the cell is interrupted.

## Relay Modes

The 9950-X relays are selectable and configurable and can be used as switches that respond when the process value moves above or below a user-defined setpoint or it can be used to generate a pulse at a rate proportional to the process value. They can be used for Low Alarm, High Alarm or Proportional Pulse triggering related to the process value. All relay functions are set up in the RELAY menus.

- ◊ Relay energized
- ◆ Relay de-energized



### □ Proportional Pulse Operation:

The Chlorine Controller can output a pulse at the rate defined by the settings in the CAL menu and the sensor input. The maximum pulse output is 300 pulses per minute.

As the process value rises above the setpoint, the output will start pulsing in relation to the process value, the maximum pulse endpoint and the programmed pulses/minute. The pulse rate will change as the process value changes and approaches the programmed endpoint. This functionality can be used to precisely control the process.

The starting point, endpoint and maximum pulse rate are selectable in the RELAY menus.

Typical usage would be to control solenoid-operated dosing pumps.

**NOTE:** Relay LEDs will flash in PULSE mode.

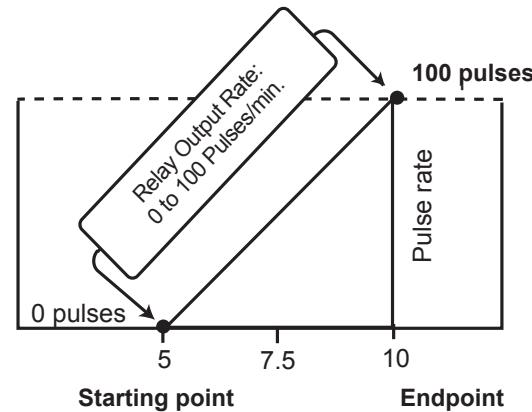
The 9950-X supports the ability to activate the Red Backlight when a relay is activated. An optional check box is displayed during the programming of a relay that will turn the Red Backlight on when the relay is activated. The Red Backlight can be activated by any relay or relay mode.

### ◊ Low Setpoint:

Relay is on when the measured value is less than or equal to the setpoint. Relay turns off when the measured value is equal to or greater than the Low Setpoint + Hysteresis.

### ◊ High Setpoint:

Relay is on when the measured value is greater than or equal to the setpoint. The relay turns off when the measured value is less than or equal to the High Setpoint - Hysteresis.



In the example:

- The output will be 0 pulses/min. when value is less than 5.
- The output will be 50 pulses/min. when value is 7.5.
- The output will be 100 pulses/min. when value is 10 or greater.

## Menu System

### VIEW Mode Overview

The top level of screens are referred to as the **VIEW Mode**. The VIEW Mode displays the sensor measurement values, sensor raw measurement data, current output and relay status. The horizontal bar graph represents the primary measurement value that is also displayed in the numeric field above the bar graph. The bar graph is primarily used to display the full scale range of the sensor, but can be scaled via the OPTION menu item.

During normal operation, the 9950-X displays the VIEW mode.

- To select a display, press the **▲** or **▼** arrow keys. The display selections scroll in a continuous loop.
- Changing the display selection does not interrupt system operations.
- No password is necessary to change display selection.
- Output settings cannot be edited from the View Mode.
- The display will return to the VIEW Mode if no button is pressed for 10 minutes.

### MENU Mode Overview

The MENU Mode enables the user to view and configure all menu items.

The five menus available are: **CAL**, **INPUT**, **LOOP**, **RELAY** and **OPTION**.

MENU Mode is entered by pressing and holding **ENTER** for three seconds.

To select a menu, use the **▲** and **▼** arrow keys to highlight the desired menu and press **ENTER** to select the menu.

In the selected menu, use the **▲** and **▼** keys to navigate through the menu. Use the **▲**, **▼** and **►** keys to edit the selected item.

To save the new selection, press the **ENTER** key. A message displaying "Saving" will be displayed for 3 seconds. After this message is displayed, the newly selected value will be displayed, if applicable. To abandon the changes press the **▲** and **▼** arrows simultaneously.

### Password Overview

The password is often required to start editing. Once entered correctly, this password will not be needed for subsequent edits, until the menu system is exited.

The password is required when the menu system is re-entered.

Your choice of password (STD or CODE) is selected in the Options Menu.

#### • STD

The standard (STD) password is **▲▲▲▼**, pressed in sequence. This password is designed to protect the 9950-X from unintentional changes. It is best suited for systems where a group of people need to be able to change settings.

#### • CODE

The CODE default setting is 0000, adjustable to any 4-digit numerical code up to 9999. Using a personal code provides the maximum degree of security.

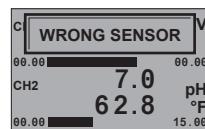
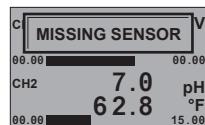
This code can be modified in the Options menu.

#### Password Reset

Turn off 9950-X press and hold all 4 keys on keypad while turning on 9950-X and unit will revert back to STD password.

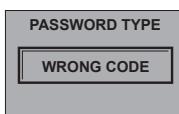
### Error Handling

Errors occurring while on the measurement screens show a specific message (e.g., Wrong Sensor). Once the error is resolved or cleared, the error message stops.



### Scrolling

In some cases, more than one message or measurement may need to be displayed. This is accomplished by alternating the message portions across the screen.



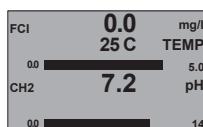
In the MENU mode, if the wrong code or password is entered, an ERROR message is displayed.



To change your CODE, go to OPTIONS mode, enter your desired code and press ENTER. (The STD password cannot be changed).

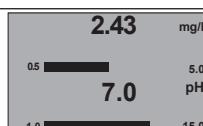
## VIEW Mode

### 9950-X VIEW Mode



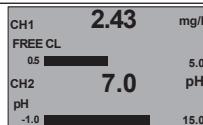
#### View Measurement Display 1

Displays the primary (top line) and secondary (bottom line) values from the sensors assigned to Channel 1 and 2. If the Bar Graph feature is enabled in OPTION menu, the bar graphs will also be visible. If Channel 2 doesn't have a sensor assigned to it, the area will be blank. This is the default VIEW display and does not time out.



#### View Measurement Display 2

Channel 1 electrode information: Chlorine sensor primary value and visual bar graph on top line. Channel 2 electrode information: pH primary value and visual bar graph on bottom line.



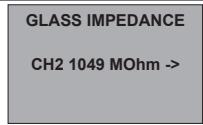
#### View Measurement Display 3

Channel 1 electrode information: primary value, bar graph and custom name on top line. Channel 2 electrode information: primary value, bar graph and custom name on bottom line.



#### Electrode Wellness Information

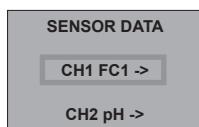
Channel 1 electrode information: Chlorine sensor raw nanoamps (nA) value  
Channel 2 electrode information: pH electrode millivolt (mV) value



pH only, last measured glass impedance, press ► key to manually update reading.

Select which sensor data to be reviewed by using the ▲ and ▼ arrows.

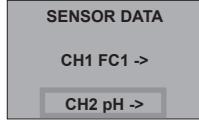
CH 1 Using the ► key, you will see the following screens:



[CI Sensor S/N]  
[CI Type and Range]  
[ZeroCAL: ppm & nA]  
[In Proc: ppm & nA]  
[Temp at CAL]  
[pH at CAL]  
[Temp Offset]  
  
[Elapsed Time]  
[Low & High: C]

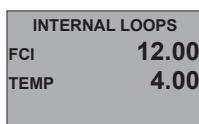
Electrode Serial Number  
Identify the chlorine sensor type connected and its ppm range  
View user entered Zero Calibration data in ppm and nA  
Users in process calibration value when it is entered in the Calibration Menu  
Temperature recorded during user In-Process Calibration  
pH value recorded during user In-Process Calibration  
Temperature offset calculated from user-entered temperature calibration from Calibrate Menu  
Total hours of operation  
Lowest and highest temperatures the CI sensor has been subjected to during operation

CH 2 Using the ► key, you will see the following screens:

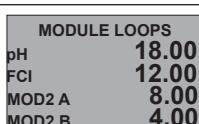


[Serial Number]  
[Model Number]  
[pH Sensor Efficiency]  
[pH Offset Calibration]  
[Factory Impedance]  
[Usage Time]  
[Minimum pH]  
[Maximum pH]  
[Minimum Temperature]  
[Maximum Temperature]

Electrode Serial Number  
Electrode Model Number  
Calibration Slope Value  
Offset  
pH only, Factory pH glass Impedance  
Electrode Runtime in Hours  
Minimum Measured Value  
Maximum Measured Value  
Minimum Measured Temperature  
Maximum Measured Temperature



Displays the internal 4 to 20 mA LOOP output for each channel assigned primary and secondary sources. (3.6, 22.00 are error output values).



Displays the Module 4 to 20 mA LOOP output for each channel assigned primary and secondary sources. (3.6, 22.00 are error output values).

## VIEW Mode

<b>RELAY STATUS</b> RELAY 1 ON RELAY 2 OFF RELAY 3 OFF RELAY 4 OFF	Relay status is stated to the right of the relay number as (OFF, ON) for each relay.
<b>BINARY STATUS</b> FLOW SWITCH OFF BINARY 2 ON BINARY 3 OFF BINARY 4 ON	When the flow switch is enabled, the label for Binary Input will automatically change to FLOW SWITCH. The Binary labels can be manually configured. Binary labels can be edited by pressing ► on the Binary Status screen and scrolling through the Binary Label submenu. Pressing Cancel (▲ and ▼ simultaneously) returns to the Binary Status screen in View Mode. English, French, German, Italian and Spanish only. Binary status is stated to the right of the binary channel number as (OFF, ON) for each of the four binary inputs.
<b>MODBUS STATUS</b> ADDRESS 999 BUS MSG CNT 99999 9950 MSG CNT 99999 MSG ERR CNT 99999	If there is no module installed, the error code "Missing Module" will appear and blink.
<b>SYS CONFIG</b> CH1 FREE CI CH2 pH RELAY 399504033 MOD1 399504048 MOD2	SYS CONFIG shows channel, parameter and relay module part number.
<b>GENERATION 2</b> SW VER 00-06 9950 S/N 0123456789	Generation Screen shows version of software and serial number of unit.
<b>MENU -&gt;</b>	MENU-> will allow access to top level menu by pressing the ► key.
<b>DATE</b> 09/01/2016 09:06	DATE and TIME display show the current system date and time

### Important

The Relay, Mod1 and Mod2 number returned by the Sys Config Screen is not the Mfr. Part No. To convert from the displayed number to the GF Mfr. Part No. use the chart below.

Module	RELAY, MOD1 or MOD2	Mfr. Part No.
Dual Channel 4 to 20 Out	39950408	3-9950.398-2
Modbus Module	39950409	3-9950-395M
Relay Four Mechanical	399504031	3-9950.393-1
Relay Two SS and Two Mechanical	399504032	3-9950.393-2
Relay Two Mech and Four Binary	399504033	3-9950.393-3

## Calibration



For greater accuracy the initial calibration of the system must be performed in the following order:

1. Temperature (only required on the initial start up of the FCI electrode).
2. pH electrode (2 point calibration required using pH buffer 7 and pH buffer 4 or 10).
3. Zero calibration, single point calibration in DI water.
4. Chlorine sensor. (Single point calibration using a DPD reference).
  - Before initial calibration, the FCI electrode must be connected in the 3-2650-7 electronics and system powered. The Chlorine electrode must be installed in the flow cell with chlorinated water flowing through the flow cell for at least 4 hours.
  - It is recommended that the FCI electrode be process calibrated 24 hours after the initial "Start up" calibration.
  - Chlorine and pH calibration screens will be shown only when a valid sensor is detected.
  - Chlorine calibration should be stable per EPA 334.0 and should require additional calibration every 14 to 21 days.
  - pH calibration is required over a period of time established by the customer based on the application requirement.

### WARNING Temperature Calibration

Calibrate temperature element: Must be performed on new chlorine electrodes.

The temperature element is located in Chlorine Electrode (CH 1), see screens 1 and 2 below.

Once calibrated the temperature element does not have to be calibrated for the life of the chlorine electrode.

### Chlorine Electrode Calibration

<b>CH 1 FREE CI</b> <b>OFF</b> <b>HOLD OUTPUTS</b>	ON prevents relays from activating while making adjustments and relays in PULSE mode will suspend pulsing. 4 to 20 mA output is held until the user exits the CAL menu or turns it OFF. Select ON/OFF. Default = OFF
<b>CH 1 TEMP</b> <b>SET</b> <b>TEMPERATURE -&gt;</b>	Enter process temperature from a reference thermometer: °C or °F. Units are set up in the INPUT Menu. <b>CAUTION:</b> Refer to the calibration procedure on page 13
<b>CH 1 FREE CI</b> <b>SET</b> <b>ZERO CAL</b>	The ZERO CAL is only required to be performed when a chlorine electrode is initially installed. The chlorine sensor should be placed in a beaker of non-chlorinated water (DI water). When ► is pressed, the LIVE readings in nA is displayed, but cannot be edited. Once the nA are stable press ENTER to save the ZERO OFFSET.
<b>CH 1 FREE CI</b> <b>SET</b> <b>IN PROCESS -&gt;</b>	Enter process chlorine value determined by customer supplied DPD test kit.
<b>CH 1 FREE CI</b> <b>LAST CAL</b> <b>MM - DD - YYYY</b>	After a successful chlorine calibration the LAST CAL display is automatically updated and date stamped with the date of the calibration.
<b>CH 1 FREE CI</b> <b>NEXT CAL</b> <b>MM - DD - YYYY</b>	Operator manually enters the next required calibration date. To avoid an immediate error code, this date must be at least one day after the LAST CAL date. A warning will show up on the chlorine sensor channel showing "Calibration is Due". To override this warning the operator can input a year that is several years away (ie 2050).
<b>CH FREE FCI</b> <b>RESET CAL</b>	This menu resets CI readings and Zero Calibration back to Factory Calibration. <b>WARNING!</b> User entered CI calibration settings will be lost, the Temperature, Zero Point and Process Calibration will need to be done again.

## Calibration

### pH Electrode Calibration

<b>CH 2 pH</b>	ON prevents relays from activating while making adjustments and relays in PULSE mode will suspend pulsing.
<b>OFF</b>	4 to 20 mA output is held until the user exits the CAL menu or turns it OFF.
<b>HOLD OUTPUTS</b>	Select ON/OFF. Default = OFF
<b>CH 2 pH</b>	Applies an offset to the pH measurement. The slope value and the standard value must be at least 2 pH units apart. The ideal values are the minimum and maximum values of your process.
<b>SET</b>	An error message is displayed if offset is too high.
<b>pH STANDARD -&gt;</b>	
<b>CH2 pH</b>	Applies a slope to the pH measurement. The slope value and the standard value must be at least 2 pH units apart. The ideal values are the minimum and maximum values of your process. An error message is displayed if the slope is too high or low.
<b>SET</b>	
<b>pH SLOPE -&gt;</b>	
<b>CH 2 pH</b>	After a successful pH calibration, the LAST CAL display is automatically updated and date stamped with the date of the calibration.
<b>LAST CAL</b>	
<b>12 - 31 - 2015</b>	
<b>CH 2 pH</b>	Operator manually enters the next required calibration date.
<b>NEXT CAL</b>	A warning will show up on the pH sensor channel showing "Calibration is Due".
<b>MM - DD - YYYY</b>	To override this warning, the operator can input a date that is several years away (ie 2050).
<b>CH2 pH</b>	Press ► to reset pH calibration to factory default.
<b>SET</b>	This is useful to wipe out suspected corrupted calibration process prior to performing a new calibration.
<b>RESET pH CAL -&gt;</b>	

## INPUT Menu



Allows manual selection of sensor type assigned to the channel.  
Channel 1 is dedicated to Chlorine electrodes (FCI and ClO2) Channel 2 is dedicated to pH electrode.

Allows user to reset 9950-X Chlorine Controller to Factory settings or select "NONE" for sensor input.  
This feature is used when a pH electrode is not being used (ClO2).

Allows user to configure electrode specific parameters such as selecting engineering units, Temperature (°C or °F) and Chlorine (mg/l or PPM).

**Note:** User is strongly discouraged from changing the sensor type away from the correct sensor.

<b>CH 1 FREE CI -&gt;</b>  <b>CH 2 pH -&gt;</b>	Select the desired channel. Channel 1 is dedicated to Chlorine electrodes (FCI and ClO2). Choose FACTORY, FREE CI or ClO2.
<b>CHANNEL 1</b>  <b>NAME</b>  <b>FREE CI</b>	Assign a specific name to the measurement point. Default name is the electrode type.
<b>CHANNEL 1</b>  <b>PPM</b>  <b>UNITS</b>	Select the Engineering units to be displayed. Select PPM or MG/L (Default PPM)
<b>CH 1 FREE CI</b>  <b>°C</b>  <b>TEMP UNITS</b>	Select the Engineering units of the Temperature on the display. Select °C or °F. (Default is °C)
<b>CH 1 FREE CI</b>  <b>AVERAGE</b>  <b>OFF</b>	Dampens Display, Output and Relay Response Rate. Select LOW, MED, HIGH, OFF Default = OFF
<b>CH 1 FREE CI</b>  <b>TYPE</b>  <b>FREE CI</b>	Current Channel type is listed. Manually change the channel type to match sensor type if sensor is not found by S <sup>3</sup> L. Select FACTORY, FREE CI, ClO2 DEFAULT = FACTORY, the 2751-7 (pH Electronics) and 2650 (Chlorine Electronics) will automatically be found by the controller.

## INPUT Menu

### pH INPUT Menu

<b>CH 1 FREE CI -&gt;</b>  <b>CH 2 pH -&gt;</b>	Select sensor type assigned to the channel. Channel 2 is dedicated to pH electrode. Choose FACTORY, NONE (use with ClO2) or pH electrode.
<b>CHANNEL 2</b>  <b>NAME</b>  <b>pH</b>	Assign a specific name to the measurement point. Default name is the electrode type (Free Chlorine or NONE for Chlorine dioxide).
<b>MANUAL pH</b>  <b>OFF</b>	Select MANUAL pH or Electrode. If manual pH is set to "OFF", the pH value from a connected pH electrode will be used for FREE CHLORINE calculations and pH measurement. When manual pH is selected "ON", a pH value manually entered is used for all Chlorine calculations.
<b>MANUAL pH VALUE</b>  <b>7.00</b>  <b>pH</b>	Enter your pH value here if a pH electrode is not connected. Default value = 7.00
<b>CH 2 pH</b>  <b>AVERAGE</b>  <b>OFF</b>	Dampens Display, Output and Relay Response Rate. Select LOW, MED, HIGH, OFF Default = OFF
<b>CH 2 pH</b>  <b>TYPE</b>  <b>pH</b>	Current Channel type is listed. Manually change the channel type to match sensor type if sensor is not found by S <sup>3</sup> L. Select NONE, FACTORY, pH DEFAULT = FACTORY, the 2751-7 (pH Electronics) will automatically be found by the controller. Select NONE when using Chlorine dioxide with NO pH electrode.

## 4 to 20mA Output (LOOP Output)



The following can individually be set for each loop on the 9950-X.

Loops 1 and 2 are in the 9950-X base unit.

Loops MOD1 A and MOD1 B are present when a loop module is in the Module 1 Slot.

Loops MOD2 A and MOD2 B are present when a loop module is in the Module 2 Slot.

LOOP 1 SOURCE NONE	Select source for each loop. Choose NONE, FCL, ClO <sub>2</sub> , pH or Temperature. Temperature values are from the Chlorine sensor.
LOOP 1 LABEL FCI	English, French, German, Italian and Spanish languages only. A custom label can be assigned to the loop for ease of identification. Default name will be the SOURCE sensor type chosen above.
L1 4 mA SETPOINT 0.00 PPM	(ALL) Set value corresponding to desired 4 mA output. 6 digits max. Default = 0 ppm (Chlorine), 0 (pH), 0 °C (32 °F) (Temperature)
L1 20 mA SETPOINT 5.00 PPM	Set value corresponding to desired 20 mA output. 6 digits max. Defaults = 5.0 ppm (Chlorine), 14 (pH), 45 °C (113 °F) (Temperature)
LOOP 1 ERROR VALUE 22 mA	(ALL) Set desired LOOP output value when sensor error (e.g., bad sensor, broken wire) is detected. Select (3.6 mA, 22 mA, or NONE). Default = 22
L1 ADJUST 4 mA 4.00 mA	(ALL) Allows fine-tuning to compensate for errors in other equipment connected to the 9950-X. Adjust the current output at 4 mA. The display value represents the precise current output. Adjustment limits: from 3.80 mA minimum to 5.00 mA maximum. Default = 4.00 mA
L1 ADJUST 20 mA 21.0 mA	(ALL) Allows fine-tuning to compensate for errors in other equipment connected to the 9950-X. Adjust the current output at 20 mA. The display value represents the precise current output. Adjustment limits: from 19.00 mA minimum to 21.00 mA maximum. Default = 20 mA.
L1 TEST LOOP 12.05 mA	(ALL) Press ▲ or ▼ to manually control the output current value from 3.8 mA to 21.00 mA to test the output of LOOP. The current loop will revert to automatic control when this menu item is left.

## Relay Menu



### CHEMICAL GUARD Menu

<b>FLOW SWITCH?</b> NO	A flow switch is necessary to enable the Chemical Guard feature. Verify the use of a flow switch by selecting YES. If NO is selected Chemical Guard will not be accessed and will go to Standard Relay Mode.
<b>RELAY 1</b> <b>CHEMICAL GUARD</b> OFF	Enable the Chemical Guard feature by changing to ON. If Chemical Guard is not enabled go to RELAY 1 source by pressing ▼ once. See Standard Relay information on page 20.
<b>OXIDIZER</b> <b>MODE</b> OFF	RELAY 1 will automatically be assigned to control Oxidizing chemicals using the Input source of the Chlorine Sensor (CH1). MODE available are LOW, HIGH or PROPORTIONAL PULSE. <b>NOTE:</b> Chemical Guard must use a pH electrode. If the pH input is changed to MANUAL pH input, the Chemical Guard feature is disabled and the standard relay modes must be used control the system until the pH electrode is replaced.
<b>RELAY 1</b> <b>LABEL</b> OXIDIZER	English, French, German, Italian and Spanish languages only. A custom label can be assigned to the relay for ease of identification. Default name will be the "Oxidizer".
<b>OXIDIZER SET LOW</b> 0.00 PPM	Relay turns on if the process measurement is equal to or lower than this value and the pH value is correct. Set to desired value. See Chemical Guard overview.
<b>OXIDIZER SET HIGH</b> 0.00 PPM	Relay turns on if the process measurement is equal to or higher than this value and the pH value is correct. Set to desired value. See Chemical Guard overview.
<b>OXIDIZER MODE</b> <b>MODE</b> PROP PULSE	Proportional Pulse Mode varies the frequency of pulses in direct proportion to minimum and maximum set points.
<b>OXIDIZER PULSE MIN</b> 5.00 PPM	Enter the desired minimum set point (END POINT) of the application. The number of pulses will be reduced to the chemical dosing pump as the set point is reached to prevent overdosing of chemicals. Default = 5.00 ppm
<b>OXIDIZER PULSE MAX</b> 0.10 PPM	Enter the maximum off set (START POINT) from desired set point (SEND POINT) of the application. This is usually the maximum allowable OFF SET value from the set point of the application. The closer to the starting point the more pulses will be sent to the chemical pump. Default = 0.01 ppm
<b>R1 MAX RATE</b> 120.00 PULSES/MIN	Set desired maximum pulse rate (300 max) <b>NOTE:</b> Pulse width fixed at 100 ms.

## Relay Menu

### CHEMICAL GUARD Menu

<b>RELAY 1 ACTIVATE</b>	Select YES to have the Red Backlight illuminate during relay activation, NO to not have the Red Backlight activated by the relay activation.
<b>RED BACKLIGHT</b>	
<b>NO</b>	
<b>pH ADJUST</b>	RELAY 2 will automatically be assigned to control pH adjusting chemicals using the Input source of the pH Electrode (CH2). MODE available are LOW, HIGH or PROPORTIONAL PULSE.
<b>MODE</b>	<b>NOTE:</b> Chemical Guard must use a pH electrode. If the pH input is changed to MANUAL pH input, the Chemical Guard is disabled and the standard relay modes must be used to control the system until the pH electrode is replaced.
<b>OFF</b>	
<b>pH ADJUST</b>	Relay turns on if the process measurement is equal to or lower than this value.
<b>SET LOW</b>	Set to desired value.
<b>0.00</b>	See Chemical Guard overview.
<b>RELAY 2</b>	English, French, German, Italian and Spanish only.
<b>LABEL</b>	A custom label can be assigned to the relay for ease of identification.
<b>OXIDIZER</b>	
<b>pH ADJUST</b>	Relay turns on if the process measurement is equal to or higher than this value.
<b>SET HIGH</b>	Set to desired value.
<b>0.00</b>	See Chemical Guard overview.
<b>pH ADJUST</b>	Enter the desired minimum set point (END POINT) of the application. The number of pulses will be reduced to the chemical dosing pump as the set point is reached to prevent overdosing of chemicals.
<b>PULSE MIN</b>	Default = 8.00 pH
<b>7.00 pH</b>	
<b>pH ADJUST</b>	Enter the maximum offset (START POINT) from desired set point (SEND POINT) of the application.
<b>PULSE MAX</b>	This is usually the maximum allowable OFFSET value from the set point of the application.
<b>8.00 pH</b>	The closer to the starting point the more pulses will be sent to the chemical pump. Default = 7.00 pH
<b>R1 MAX RATE</b>	Set desired maximum pulse rate (300 max)
<b>120.00</b>	<b>NOTE:</b> Pulse width fixed at 100 ms.
<b>PULSES/MIN</b>	
<b>RELAY 2 ACTIVE</b>	Select YES to have the Red Backlight illuminate during relay activation, NO to not have the Red Backlight activated by the relay activation.
<b>RED BACKLIGHT</b>	
<b>NO</b>	
<b>RELAY 2</b>	(ALL) Press ▲ or ▼ to turn relay on or off for testing purposes.
<b>TEST RELAY</b>	

## Relay Menu

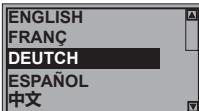
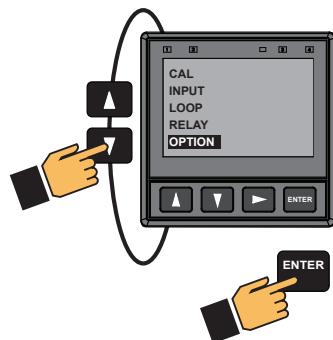
### STANDARD RELAY Menu

RELAY 1 SOURCE NONE	All relay sources can be assigned to Relay 1 – 4. Choose NONE, FCI, ClO <sub>2</sub> , pH, Temperature, Binary 1 – 4. If CHANNEL 1 is assigned a chlorine sensor the temperature source comes from the chlorine sensor.
RELAY 1 MODE OFF	(ALL) Select the desired mode of operation for the (R1) output (OFF, LOW, HIGH, PROP PULSE, ERROR mode) (See page 18, Relay Modes). Default = OFF. Continue stepping through to select R2, R3 and R4 output modes. When MODE is set to ERROR, relay turns on if sensor problem is detected on either channel. ON DELAY delays the turning on of the relay until after the programmed delay time.
RELAY 1 LABEL RELAY 1	English, French, German, Italian and Spanish only. A custom label can be assigned to the relay for ease of identification.
R1 SET LOW 0.10 PPM	(ALL) (Shown if LOW mode) Relay turns on if process measurement is equal to or lower than this value. Set desired value. Default = Chlorine 0.10 PPM, Temperature 25 C, pH 4.0
R1 SET HIGH 5.00 PPM	Relay turns on if process measurement is equal to or higher than this value. Set desired value. Default = Chlorine 5.00 PPM, Temperature 45 C, pH 8.0
R1 HYSTERSIS 0.50 PPM	Hysteresis prevents the mechanical relays from chattering around the set point. Set amount (in units of measure from INPUT Mode) to add to SET LOW or SET HIGH values.
R1 ON DELAY 5.0 SEC	Set seconds (up to 9999.9) to wait before activating relay once the relay condition is true.

**NOTE:** Screens below are only visible when Porportional Pulse Mode is selected.

R1 PULSE MIN 5.00 PPM	Enter the desired minimum set point (END POINT) of the application. The number of pulses will be reduced to the chemicl dosing pump as the set point is reached to prevent overdosing of chemicals. Default = Chlorine 5.00 PPM, Temperature 45 C, pH 8.0
R1 PULSE MAX 0.10 PPM	Enter the maximum off set (START POINT) from desired set point (SEND POINT) of the application. This is usually the maximum allowable OFF SET value from the set point of the application. The closer to the starting point the more pulses will be sent to the chemical pump. Default = Chlorine 0.10 PPM, Temperature 25 C, pH 4.0
R1 MAX RATE 120.00 PULSES/MIN	Set desired maximum pulse rate (300 max) <b>NOTE:</b> Pulse width is fixed at 100 ms.
RELAY 1 ACTIVATE RED BACKLIGHT NO	Select Yes to have the Red Backlight illuminate during relay activation, No to not have the Red Backlight activated by the relay activation.
RELAY 1 TEST RELAY	(ALL) Press ▲ or ▼ to turn relay on or off for testing purposes. Can also be used to reset or latch/unlatch the relay. Does NOT reset the Totalizer.

## OPTION Menu



Choose desired the language for the 9950-X. Default = English

### TIME FORMAT

24 HR

Choose a time format between a 24 Hour or an AM/PM clock. Default = 24 HR

### SET TIME

08:56

Set the time according to the format chosen 00:00

### DATE FORMAT

MM/DD/YYYY

Date Format; MM/DD/YYYY, DD/MM/YYYY, YYYY/MM/DD

### SET DATE

02/25/2016

Set the date according to the format chosen 00/00/0000

### SET DECIMAL MARK

999.99

Choose either comma or point according to local practices. Default = 999.99 (point).

### SELECT UNITS

METRIC

Choose METRIC or US CUSTOMARY

### CONTRAST

3

Adjust the displays contrast for best viewing. A setting of 1 is lower contrast, 5 is higher and 3 is default.

## OPTION Menu

WHITE BACKLIGHT AUTO LOW	White Backlight: OFF, LOW, HIGH, AUTO LOW, AUTO HIGH
RED BACKLIGHT ON	The Red Backlight illuminates when an error condition is detected or user selected relay(s) are activated. Default = ON
DISPLAY BAR GRAPH ON	Display Bar Graph: ON, OFF When enabled, user enters range to be displayed.
PASSWORD TYPE STD	(ALL) Select STD, CODE. Default = STD (Refer to page 22 for further detail)
PASSWORD TYPE CODE	(CODE) If code is selected Default Code = 0000 (Refer to page 22 for further detail)
CH2 BAR GRAPH MIN 0.00 PPM	Enter a value to represent bar at minimum. Default = 0
CH2 BAR GRAPH MAX 100.00 PPM	Enter a value to represent bar at maximum. Defaults = 5.00 ppm (Chlorine), 14 (pH)
CH1 ---- PPM DECIMAL	(ALL) Set the decimal to the best resolution for your application for both CH1 and or CH2. The display will automatically scale up to this resolution for each channel. Select 0, 1, 2, 3, or 4 decimal places, (varies by parameter). Default = 1 Decimal Place
CH1 ---- °F DECIMAL	(Chlorine electrodes) Set the Temperature decimal to the best resolution for your application for CH1. The display will automatically scale up to this resolution. Select 0, 1, or 2. Default = 1 Decimal Place
MEMO MEMO	(ALL) Enter 17-character string, if desired. Default = MEMO

## Modbus Menus

	<b>MODBUS</b> MODULE NONE	Select NONE, MOD 1 or MOD 2. The MODBUS module must be installed into Module 2 of the 9950-X.
	<b>MODBUS</b> COMMUNICATION SETTINGS ->	Press the ► key to change the settings of the Modbus Module. See page 36 for Modbus Communication Settings Menus.
	<b>MODBUS</b> REMOTE UPDATE NO	Setting Modbus Remote update to YES allows remote Modbus device to change the settings on the 9950-X. Setting Modbus Remote Update to No prevents remote devices from make any changes to the 9950-X. Remote device will still be able to read all of the Modbus parameters.
	<b>9950</b> GENERATION 3	Displays Chlorine Controller Generation Version.
	<b>USER MANUAL</b> 	QR code for user manual.

## Modbus Menus

### OPTION Menu

MODBUS  
COMMUNICATION  
SETTINGS ->

Press the ► key to change the settings of the Modbus Module

### Modbus Communication Settings Menus

MODBUS  
ADDRESS  
95

Set the Modbus address of the 9950-X.  
The default address is 95

NETWORK  
TERMINATION  
NO

The 9950-X Modbus Module has an electronic termination network.  
The Termination can be activated by setting the value to Yes.  
The default value is No (the termination is off).

MODBUS  
BAUD RATE  
19.2 K

Set the baud rate of the Modbus network.  
The default value is 19.2K baud, 19200 baud.

MODBUS  
PARITY  
EVEN

Set the parity of the Modbus network.  
The default value is Even parity.

MODBUS  
ENDIAN  
BIG

Set the byte order in which the 9950-X transmits floating point numbers in the Modbus protocol.  
The default value is Big Endian.

RESET TO  
DEFAULT  
NO

Reset all Modbus setting to the default values.

ACTIVATE  
SETTINGS  
NO

ACTIVATE SETTINGS:  
YES sends the changes to the Modbus Module, NO keeps the current settings

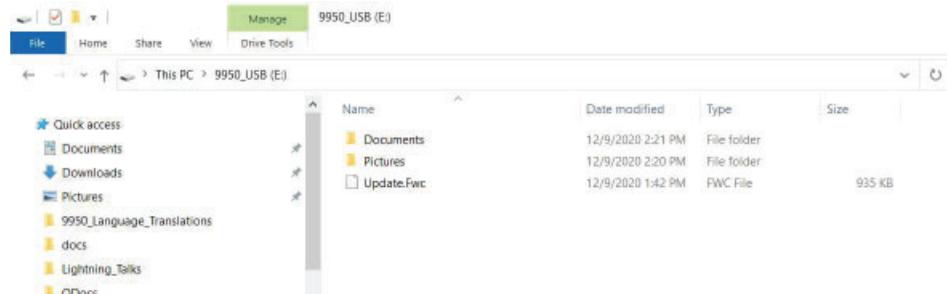
## 9950 Field Software Upgrade

The 9950 upgrade file will be available on the Georg Fischer website. You will need a USB flash drive that is formatted, using Microsoft Windows, in either FAT16 or FAT32 format. **Do not** use exFAT or NTSF formats. These are incompatible with the 9950.

The upgrade file is named Update.Fwc. Copy the file to the root directory of the Flash Drive. Do not change the name of the file or store the file in a sub directory on the Flash Drive. The 9950 will only look in the root directory for the specific file, Update.Fwc.



**Important!** Do not use a USB extension cable. The USB flash drive must be directly connected to the 9950 USB port.

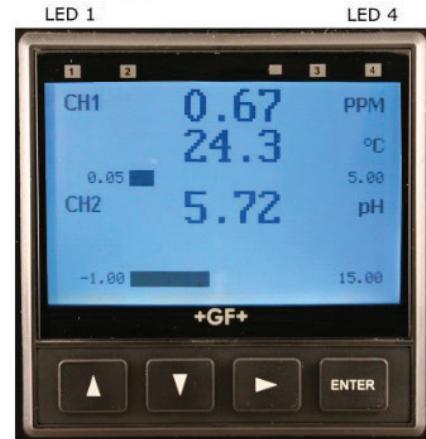


Sample Flash Drive Directory with Update File

## Updating the 9950

Updates available on [www.gfps.com](http://www.gfps.com).

1. Disconnect power from the 9950.
2. Insert the Flash Drive into the 9950 USB slot.
3. Reconnect power to the 9950.
4. LED 1 on the 9950 will flash quickly as the unit searches for a Flash Drive and the correct file.
5. When the 9950 detects a Flash Drive and a valid update file, LED 2 will slowly flash during the update process.
6. The update process takes approximately 30 seconds.
7. After a successful update the 9950 will boot to the normal screen.
8. If the update is successful, disconnect power, remove USB drive, reconnect power and review application settings.



## Troubleshooting

If, after 10 seconds, the unit boots to the normal screen, the 9950 was unable to find the Flash Drive or the file.

- a. Verify the Flash Drive has been formatted in either FAT16 or FAT32 format, the upgrade file is in the root directory of the Flash Drive, and the file name is Update.Fwc. You may also need to try a different flash drive.
- b. If LED 4 on the 9950 is continuously illuminated, this indicates either the file found on the Flash Drive is corrupted, or power was interrupted during the upgrade process. Remove power from the 9950. Remove the Flash Drive. Apply power to the 9950.
- c. If the 9950 starts normally, the file on the Flash Drive was corrupted. Download a new copy of the update file and copy it to the Flash Drive. Repeat the update instruction with the new file.
- d. If the 9950 starts up and stops with LED 4 on and a blank screen, this indicates that the update process was interrupted and the 9950 cannot start. Disconnect power from the 9950. Reattach the Flash Drive to the 9950. Repeat the upgrade procedure.
- e. If the 9950 still does not respond after the second upgrade attempt to: Download a new copy of the update file and copy it to a different Flash Drive. Repeat the update instruction with the new Flash Drive.

## Troubleshooting

Condition	Possible Causes	Suggested Solution
<b>Wrong Sensor</b>	Incorrect sensor installed on channel	Connect correct sensor to channel
	Sensor Type set incorrectly in 9950-X	Set correct sensor TYPE in INPUT menu (see page 27)
<b>Wrong Code</b>	Wrong password entered	Enter correct password (see page 22)
<b>Backlight inoperative</b>	Backlight turned OFF <b>(NOTE:</b> Backlight can turn off automatically in AUTO mode)	Set BACKLIGHT to LOW, HIGH, AUTO LOW or AUTO HIGH in OPTION menu.
<b>Relays inoperative</b>	Relay Module installed incorrectly	Remove and reseat Relay Module
	Wrong settings in RELAY menu	Use test relay to verify relay operation then check relay settings.
	Flow Switch OFF	Turn Flow Switch ON
<b>Relay always ON</b>	Hysteresis value too large	Change the hysteresis value
	Defective Relay Module	Replace Relay Module
-----	Measurement exceeds display capability	Change unit of measure
<b>Missing Module</b>	4 to 20 mA Module or Modbus Module is not installed in the Module Slot	Install the module in the correct slot
<b>Wrong Module</b>	The wrong Module 4 to 20 mA or Modbus Module) is installed in the slot	Replace module with the correct module
<b>Calibration Due</b>	Calibration is required for all new sensors	Do the Calibration
	Calibration was reset to factory	
	Next Calibration date reached	
	Next Calibration date was not set	
<b>No pH value</b>	pH electrode faulty	Replace pH electrode
		Place pH electrode input to Manual
<b>No Flow</b>	No flow detected through the Flow Switch	Verify water source is turned ON
		Verify the flow cell outlet ball valve is open
		Disable Flow Switch input via Relay Menu
<b>Man pH</b>	Manual pH compensation has been selected	Replace pH electrode
		Set Manual pH to OFF

## Troubleshooting

Condition	Possible Causes	Suggested Solution
<b>No Probe</b> (Chlorine or pH)	9950-X "cannot communicate" with Chlorine or pH electrode	<ul style="list-style-type: none"> <li>Check wiring</li> <li>Install or replace electrode</li> </ul>
	Missing sensor or bad temperature element	
<b>Check Preamp</b> (Chlorine or pH)	9950-X "cannot communicate" with the Chlorine or pH electronics	Check wiring
		Replace 2751-7 or 2650 Electronics
<b>Backlight of Screen is RED</b>	Error is detected or Relay is activating the red backlight	Correct error condition
<b>Broken Glass</b>	pH electrode glass has been damaged and caused very low impedance	Visually inspect pH electrode for cracked and/or chipped glass
<b>Hi Impedance</b>	The measured pH electrode impedance is above the high impedance level.	Visually inspect the pH electrode and clean if necessary
	Electrode could be in air	Ensure electrode is submersed at all times
<b>Check Cal</b> (pH only)	Slope and/or Offset are out of range	Set pH Slope or Standard (pg. 32 & 60)
		Reset pH CAL (pg. 32)

## Calibration Error Messages

Message	Cause	Solution
Out Of Range Use Manual Calibration	(pH) Buffer not found; Error $> \pm 1.5$ pH units	<ul style="list-style-type: none"> <li>Use 4 and 7 pH buffers</li> <li>Clean sensor</li> <li>Use manual calibration method</li> </ul>
Err Too Large To Calibrate	(pH) Offset $> 1.3$ pH units; Slope error $> 100\%$	<ul style="list-style-type: none"> <li>Check reference</li> <li>Clean sensor</li> <li>Replace sensor</li> </ul>
Cal Error Out Of Range	Chlorine - nA out of range when compared to the DPD sample pH - Calibration exceeds the maximum offset of the reference junction allowed	<ul style="list-style-type: none"> <li>Check sensor range</li> <li>Check reference</li> <li>Replace sensor</li> </ul>
Slope Too Close To Standard	(pH) Difference in calibration values must be $> 2$ pH units	<ul style="list-style-type: none"> <li>Check sensor</li> <li>Use fresh buffer</li> <li>Use two different buffer values</li> <li>Clean sensor</li> </ul>
Standard Too Close To Slope	(pH) Difference in calibration values must be $> 2$ pH units	<ul style="list-style-type: none"> <li>Clean sensor</li> <li>Use fresh 4, 7 and 10 pH buffers</li> <li>Use two different buffer values</li> </ul>

## 2630 Amperometric Chlorine Electrodes

### Overview

#### pH Compensation for Free Chlorine

Amperometric free chlorine sensors measure only hypochlorous acid. As noted in the text above and in Figure 1, the ratio of hypochlorous acid and hypochlorite is pH dependent. The GF Free Chlorine Panel assemblies comes complete with a pH electrode to ensure accurate free chlorine measurement if the pH changes.

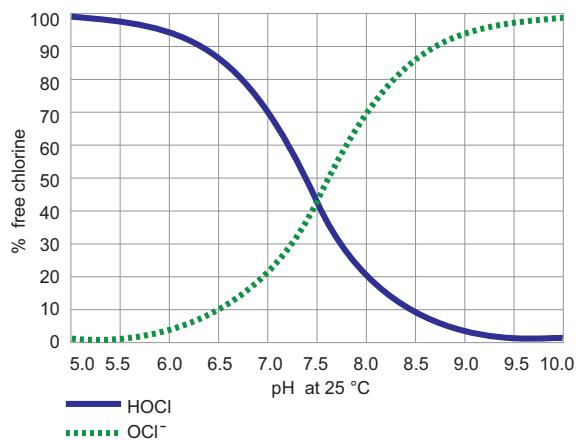


Figure 1

#### Automatic pH Compensation and Free Chlorine

In many applications, the process pH does not significantly fluctuate and only a chlorine sensor and instrument are necessary for accurate chlorine measurement.

When the pH varies the free chlorine concentration cannot accurately determined without the use of automatic pH compensation.

The addition of the 3-2724-00 (159 001 545) pH electrode along with its 3-2751-7 (159 001 957) sensor electronics to the system makes pH compensation extremely easy and automatic even with wide fluctuations or high pH.

See Figure 2 for pH variation recommendations.

Chlorine dioxide is not pH dependant and does not require a pH electrode or electronics.

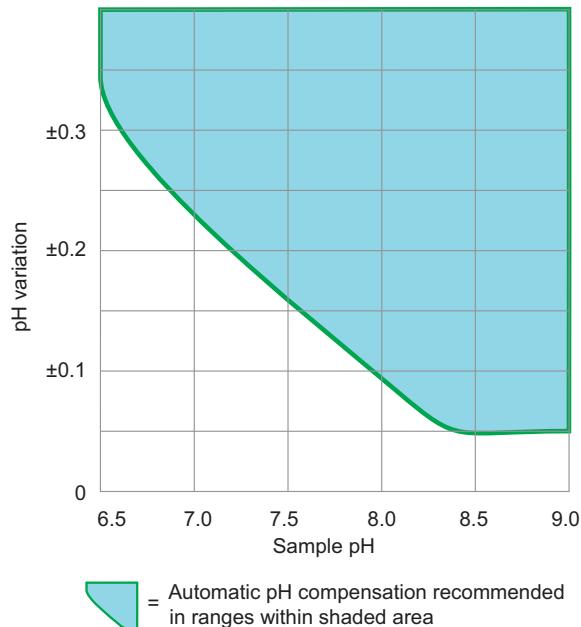


Figure 2

## Maintenance

### 2630 Free Chlorine Electrode

### 2632 Chlorine Dioxide Electrode

It is required to calibrate the sensor after servicing the membrane and electrolyte. See page 10.

Verifying the sensor's accuracy using the DPD method should be performed to determine if the sensor requires maintenance.

1. Inspect the membrane for dirt or damage. Replace the membrane if it's torn or if the gold cathode is visible.
2. If the membrane is dirty clean the membrane by soaking it in 1 - 5% HCl and gently wash with a stream of DI water (do not use any mechanical device on the membrane).

#### Refill Procedure:

When adding electrolyte, be prepared for an accidental spill. Working near a sink is recommended.

1. Remove the membrane cap from the front of the sensor.
2. Turn the sensor upside down and shake the sensor vigorously to remove the internal electrolyte.
3. Fill supplied syringe with electrolyte solution. Additional caution should be taken when handling Chlorine Dioxide electrolyte solution.
4. Place the electrode on a level surface.
5. Insert syringe needle fully into one of the eight electrode holes while injecting with electrolyte solution. Slowly injecting the electrolyte solution into the sensor to avoid introducing air bubbles. The electrode holds approximately 14 milliliters of solution. Slowly fill until solution begins to flow out of holes. Do not allow the solution to run down the electrode and wet the electrical contacts in the DryLoc connector.
6. Slowly screw on the membrane cap finger tight. Do not use tools.

**To avoid damage and contamination, do not touch the white membrane surface on the membrane cap.**

## Storage

If the sensor or panel assembly is to be removed from service for a period of time the sensor must be properly prepared for storage and may need to be recommissioned.

#### Storage Periods:

##### 1 week or less:

- Close the drain valve, then close the inlet valve of the flow cell, to maintain water inside the flow cell to keep the membrane wet.
- If draining the flow cell is required, remove the sensor from the cell and the 2650 electronics and store in the shipping bottle with tap water added.

Continue to page 42 for additional storage periods



Diluted HCl can irritate the eyes and skin, use proper safety equipment. Do not use surface tension reducing chemicals, detergents or solvents on the membrane.

- If a fresh water rinse does not clean the membrane, it will need to be replaced.
- Keep spare membrane caps available. Membrane caps carry no warranty.



**Avoid skin or eye contact with electrolyte solution. Wear rubber gloves and goggles.**

\* Safety Data Sheets (SDS) are available online at [www.gfps.com](http://www.gfps.com).



#### CAUTION:

DO NOT touch the gold-plated tip or the membrane of the sensor.



Dry electrodes are shipped and need to be stored between -10 °C to 60 °C (14 °F to 140 °F) at a relative humidity that does not exceed 95%.

The primary concerns when storing the electrode is damage to the membrane.

## Storage continued and Reconditioning

### Storage periods more than 1 week:

- Remove the membrane cap and internal electrolyte solution.
- Rinse the sensor internal chamber with DI water or cold tap water; drain and allow to dry.
- Place the membrane cap back onto the sensor. INSTALL LOOSE, DO NOT COMPLETELY TIGHTEN THE CAP. WHEN STORED DRY, THE MEMBRANE CAP MUST BE STORED RELAXED AND UNSTRESSED.
- Store sensor DRY in the shipping bottle, DO NOT ADD WATER.

### Recommissioning Procedure:

1. Fill the sensor with the electrolyte as outlined in Maintenance, see page 10, and install the membrane cap.
2. The sensor will have to be polarized in the flow cell with flowing Chlorinated water before being used. **Note:** This may take 30 to 120 minutes before calibration can be performed.
3. If the sensor does not recover after recommission, follow steps 1-10 outlined in Reconditioning.
4. If the sensor still fails to work properly, continue with steps 11-17.

### CAUTION!



Bleach and Chlorine Dioxide solutions are very corrosive and may release dangerous gases if it comes in contact with acids.

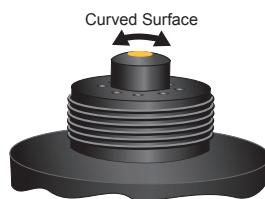
- Wear proper protective clothing (gloves and eye protection)
- Avoid contact with skin and eyes
- Observe all warnings on safety data sheets
- Avoid spilling bleach and possible contact with acids



Figure 1



Figure 2



### Required to recondition a sensor:

- DI Water
- Beaker (any size available)
- Polishing Sheets (Included in sensor maintenance kit)
- Free Chlorine: Chlorine Bleach (13% concentration)
- Chlorine Dioxide: Aqueous Chlorine Dioxide solution

### Reconditioning Procedure (Steps 1-10):

1. Remove the sensor from the 2650 electronics.
2. Remove the membrane cap.
3. Place the sensor on a firm, flat surface with gold cathode pointing upward.
4. Apply a small amount of water to the blue (coarse) polishing paper (dull side).
5. Polish the gold electrode by moving the paper in a circular pattern for 30 seconds. DO NOT go back and forth in a single direction. See Figure 1.
6. Rinse the sensor tip with DI water.
7. Apply a small amount of DI water to the white (fine) polishing paper (dull side) and polish the gold electrode by moving the paper in a circular pattern for 30 seconds. DO NOT go back and forth in a single direction. See Figure 1.
8. Rinse the sensor tip with DI water.
9. Top off the sensor with electrolyte and inspect membrane for dirt or damage. Replace if necessary.
10. Insert the sensor into the 2650-7 electronics and apply power.

### Reconditioning Procedure (Steps 11-17):

11. Fill beaker with a 12 mm (1/2 inch) of the appropriate solution.
12. Position or suspend the sensor 6 mm to 12 mm (1/4 in. to 1/2 in.) above the appropriate solution. DO NOT SUBMERGE THE SENSOR. See Figure 2.
13. Apply power to the system.
14. Monitor the nA of the sensor (press the down arrow three times on the 9950-X Chlorine Controller). The nA reading should start to rise. Response time and nA reading will depend upon the temperature of the bleach.
15. Once the sensor's nA reading reaches approximately 300-360 nA, allow the sensor to remain in the beaker, suspended over the appropriate solution, for an additional 20 minutes.
  - If sensor does not recover, cover the beaker to avoid air contamination.
  - Contact the factory for assistance ([www.gfps.com](http://www.gfps.com))
16. After 20 minutes, remove the sensor from the beaker and install it into the flow cell and restore flow to the system.
17. Calibrate the sensor after the system has become stable.

## 2724 DryLoc pH Electrode

### Electrode Date Code

- The electrode date code indicates the manufacturing date of the electrode.
- Electrodes should be put into service as soon as possible and should not remain in the box for more than two years.
- Over time, the storage solution (found in the "boot" covering the electrode tip) will evaporate or leak, allowing the delicate sensing tip and reference junction to dry.
- To rehydrate a dry electrode, soak the tip in 3.0 mol/L KCl solution for 24 to 48 hours. Preheating the KCl solution to <140 °F may speed up the re-hydration process.
- Electrodes more than 2 years old may still be functional, but will take longer to rehydrate.
- Restoration may not be effective for severely dehydrated electrodes.

First Digit = Month
N = January
M = February
L = March
K = April
J = May
H = June
G = July
F = August
E = September
D = October
C = November
B = December



Second Digit = Year
7 = 2022
8 = 2023
9 = 2024
0 = 2025
1 = 2026
2 = 2027
3 = 2028
4 = 2029
5 = 2030
6 = 2031
7 = 2032
8 = 2033

Example: L6 = manufactured in February 2022

### Electrode Care

Depending on the type of application and the accuracy needed, pH and ORP electrodes will require routine maintenance. Contaminated/dirty electrodes should be swapped with properly cleaned conditioned and calibrated electrodes.

The solution used to clean an electrode varies depending on the type of coating:

**Caution:** Always wear appropriate safety gear and exercise proper safety practices when working with or near chemicals

- General Cleaning** – Soak the electrode for 5 minutes in a mixture of warm tap water (< 140° F), and mild detergent such as liquid dish detergent. A soft brush, like a toothbrush may also be used to clean off particulates.
- Biofilm and bacterial growth** – Soak the electrode in a diluted household laundry bleach solution (pH electrodes only), 1part bleach to 10 parts water for 10 minutes.
- Alkaline or Scale** – Lime/calcium and mineral buildup deposits may be removed by soaking the electrode in a solution of 2% to 5% hydrochloric acid (HCl) or vinegar for no more than 5 minutes.
- Acidic contaminants** – May be removed by soaking the electrode in a weak caustic (less than 2% to 5% NaOH) for a few minutes only. Use the least harsh chemical which will remove the contaminant within 2-5 minutes of soaking without attacking the materials of construction.
- Oily or organic coatings** – Soak the probe for 5 to 10 minutes in a solution of warm tap water < 140° F, and dish detergent. Alternatively, use an appropriate solvent (isopropyl alcohol or similar) that will not attack the materials of construction. If required gently clean junction and/or glass with a very soft tooth brush, and follow up with brief soaking (2-5 minutes) in 2% to 5% NaOH (sodium hydroxide). In the case of pH (not ORP) a difficult organic fouling can be treated with household bleach (4-6%) as a substitute for the dish detergent.
- ORP Platinum Coating** – Gently wipe the electrode surface with a soft lint-free paper towel. If the various forms of chemical cleaning are not sufficient to achieve an accurate measurement and response time, a last resort would be to polish the platinum surface with a 0.3-1.0 micron alumina polishing slurry to remove any stubborn coatings.
- After cleaning, rinse pH/ORP electrode in distilled or tap water, then re-examine the electrode for damage that may have been hidden from view. Sensor may not initially behave properly; and have a temporary offset due to the cleaning chemistry. Proper conditioning is always recommended.

### Electrode Conditioning

Soak sensor tip (pH or ORP) in 3 mol/L KCl (potassium chloride), for at least 45 minutes to regenerate/condition.

The more aggressive the cleaning, the longer the soak in potassium chloride.

Failure to soak the electrode will cause the electrode to drift for a time after the cleaning procedure, and could adversely affect the calibration process/results.

If the cleaning and conditioning yield results within operational tolerance, the pH/ORP sensor is once again suitable for use. However, if the results do not bring the readings of the pH/ORP sensor within tolerance, it is time to replace the sensor.

## pH System Calibration

There are two functions in a pH electrode that require the system to be calibrated:

### Temperature Calibration

The temperature output of the electrode (measured by a Pt1000 RTD) must be calibrated only once.

When a new electrode is installed, it does not need to be repeated.

Because the temperature measurement has a significant influence on the electrochemical measurement, the temperature output in new pH electrodes should always be calibrated before the pH/mV calibration.

**NOTE:** All GF transmitters and controllers incorporate automatic temperature compensation.

pH error due to temperature changes in fluid												
°C	pH 2	pH 3	pH 4	pH 5	pH 6	pH 7	pH 8	pH 9	pH 10	pH 11	pH 12	
15	0.15	0.12	0.09	**0.06	0.03	0	0.03	0.06	0.09	0.12	0.15	
25	0	0	0	* 0	0	0	0	0	0	0	0	
35	0.15	0.12	0.09	0.06	0.03	0	0.03	0.06	0.09	0.12	0.15	
45	0.3	0.24	0.18	0.12	0.06	0	0.06	0.12	0.18	0.24	0.3	
55	0.45	0.36	0.27	0.18	0.09	0	0.09	0.18	0.27	0.36	0.45	

Table 1

As the pH value moves away from neutral (7 pH) or the temperature moves away from 25 °C, the electrochemical output is affected.

- \* Example: At pH 5 the mV output of the electrode is not affected if the temperature is at 25 °C.
- \*\* The electrode output will be shifted by 0.06 pH units if the temperature is reduced to 15 °C.

### Offset and Slope Calibration

The pH electrode calibration is an important function that must be done routinely to standardize the electrode due to its ever-changing characteristics. The electrode contains a gel that depletes over time, so the instrument must be readjusted periodically to maintain system accuracy. There are many influences, including aging, temperature, coatings and chemicals used that will affect the probe characteristics. After cleaning and conditioning, GF pH electrodes may be calibrated in two pH buffer solutions of different pH values (a two point calibration).

The pH electrode is calibrated by placing it in a buffer solution of known pH and measuring the cell potential. This is a linear function of pH in the range of pH 2-11, therefore two calibration points are needed. Most common calibration buffers are pH 4.01 and pH 7.00 (@ 25 °C). If the pH measurements are made in an acid to neutral range, we recommend using buffer pH 4.01 and buffer pH 7.00 for calibration. If an alkaline sample is measured, we recommend using buffer 7.00 and buffer 10.01 for calibration.

The response of the glass electrode is characterized by two parameters, offset and slope. The theoretical output of a pH electrode at pH 7 is 0 mV. The offset, or zero pH is the deviation of the pH from the nominal value. In the GF transmitters, the offset calibration is performed under STANDARD.

The glass electrode slope is the mV developed per each pH unit (mV/pH). At 25 °C, the theoretical slope is 59.16 mV/pH. So, at pH 4.01, +177 mV will be generated, while at pH 10.01 (with a lower H<sup>+</sup> concentration), a potential of -177 mV will be generated, (see Table 2). A new electrode however, will generate 0 ± 15 mV in pH 7.00 and will have a slope efficiency between 93.2 and 103%.

In the GF transmitters, manual slope calibration is performed under SLOPE.

Theoretical mV Values @ 25 °C	
pH	mV
2	+295.8
3	+236.64
4	+177.48
5	+118.32
6	+59.16
7	0
8	-59.16
9	-118.32
10	-177.48
11	-236.64
12	-295.8

Table 2

## pH System Calibration continued

### How to calculate a pH electrode slope efficiency

Two pH buffers are selected to check the pH probe performance, pH 4.01 and pH 7.00. The ratio of the measured potentials (E2-E1) to the difference of pH (7.00 – 4.01) gives the slope of the straight line.

1. Read the mV potential generated by the electrode in two calibration buffers
2. Determine the slope (the mV potential generated per pH unit)
3. Divide this number by the theoretical slope, 59.16 mV/pH @ 25 °C and multiply by 100.

#### Example 1

pH electrode generates -12 mV in pH 7.00 buffer and +162 mV in pH 4.01 buffer.  
 $160 \text{ mV} - (-12 \text{ mV}) = 172 \text{ mV}$   
 $172 \text{ mV}/3 = 57.33 \text{ mV/pH unit}$   
 $57.33/59.16 \times 100 = 96.9 \text{ % slope efficiency}$

#### Example 2

pH electrode generates -45 mV in pH 7.00 buffer and +115 mV in pH 4.01 buffer.  
 $115 \text{ mV} - (-45 \text{ mV}) = 160 \text{ mV}$   
 $160 \text{ mV}/3 = 53.33 \text{ mV/pH unit}$   
 $53.33/59.16 \times 100 = 90.1\%$

In Example 2, slope efficiency of 90.1% is acceptable but the offset of -45 mV is not. An offset shift can be the result of the reference electrode being contaminated or poisoned. A slope shift can be the result of the glass being etched or coated with a hard build-up.

As the electrode ages, the slope decreases gradually, generally a slope between 85% and 105% is acceptable. If the offset value (pH 7.00) is  $> +/- 45 \text{ mV}$ , electrode should be replaced. When a great accuracy is required from the electrode, the offset and the slope values need to be as close as possible to the theoretical values.

Refer to the Calibration Procedure section of the instrument manual for a 2 point pH calibration. If the sensor is used in a 4 to 20 mA 'blind application' refer to the Calibration section of the 2751 Smart Sensor Electronics for a 2-point EasyCal pH calibration.

## Buffer Solutions

Proper handling, storage and use of buffers is very important on the pH measurement accuracy. If the buffers are contaminated or used improperly, the calibration will be inaccurate and all subsequent measurements will be wrong.

- When calibrating pH electrodes, always use pH buffers in the range of your sample.
- To achieve an accurate calibration make sure the electrode and the buffer are at the same temperature.
- Buffers have limited shelf life. Do not use a buffer if the expiration date has passed.
- Never return used buffers to the buffer bottle. Discard it.
- Do not leave the buffer bottle open (exposed to air).  
The atmospheric carbon dioxide lowers the pH of the alkaline buffers (10.01 pH).
- To avoid contamination, rinse the electrode with distilled or tap water before placing it in the buffer. If necessary, the electrode might be blotted dry using a lint-free paper towel (e.g. Kimwipes) to remove excess water. Be extra careful not to touch or rub the surface of the glass. The wiping of the glass can produce a static charge that will interfere with the voltage reading of the electrode. In addition to this, the hydration gel layer is interrupted.
- Store buffers at room temperature.
- GF offers the following pH buffer solutions, pH 4.01, pH 7.00 and pH 10.01.
- Make fresh buffer solutions just before using.
- Dispose of all calibration solutions in accordance with local guidelines and regulations.

## Electrode Storage

Proper electrode storage maximizes electrode performance and extends electrode life.

**Prior to storage** - add 3 mol/L KCl to the electrode storage cap (about half full), and carefully secure the cap onto the electrode tip.

- Store boxed electrodes wet, flat or upright (electrode tip down) to maximize hydration of the glass surface.
- Store electrodes in stable temperature environment, avoiding freezing conditions (below 0 °C (<33° F) and heat above 100° F).
- Never store the electrode in deionized (DI) water. Use 3 mol/L KCl solution to keep the glass wet when out of the process.

**Short term storage (up to 24 hours)** - soak the electrode tip in either pH 4.01 buffer or 3 mol/L KCl solution.

- Drying out of the pH sensitive glass and the junction must be avoided (or damage to the electrode will occur).
- Prior to electrode installation, make sure there's a light film of synthetic grease (such as silicone-free grease) applied to the upper electrode O-ring. If the electrode will be installed into a GF Installation Fitting, then also apply a thin film of synthetic grease to the lower O-ring.
- Do not lubricate the bottom O-ring of the electrode if using the 4630 flow cell, see page 12.

**Long term storage (longer than 24 hrs)** - add 3 mol/L KCl solution to the storage cap (about half full) and carefully secure the cap onto the electrode tip. This will ensure probes are always ready to use.

## 463X Chlorine Analyzer Flow Cell

### Maintenance

#### Sensor Removal



**CAUTION:** Over time, a sensor can get tight in the flow cell fitting. When removing the sensor, avoid hitting the sensor electronics on the bottom of the wiring enclosure if the sensor suddenly releases. **Take care not to damage the components.**

While holding the flow cell, grasp the yellow electronics housing as a whole unit and carefully pull upwards, gently rocking back and forth if necessary. Once the sensor is loose, disengage the electronics, then remove the sensor.

**TIP:** A tool can be used to carefully pry the sensor electronics up and out if it is difficult to remove.

Under certain conditions, a dirty flow cell and filter can create a chlorine demand which could lower the chlorine concentration in the water flowing past the chlorine sensor. It is recommended to clean the filter and flow cell on a regular basis. The frequency of necessary cleaning will depend on the application in which the system is being used and the level of accuracy required.

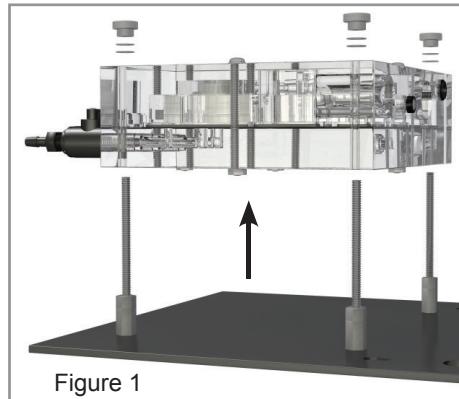


Figure 1

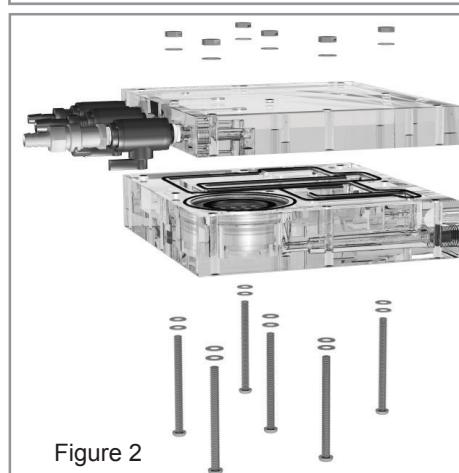


Figure 2

#### Cleaning



Service the flow cell on a clean, dirt free surface to avoid scratches or damage to the flow cell.

- Step 1.** Keep the system powered on.
- Step 2.** Disable the relays and any output loops.
- Step 3.** Turn off the water flow.
- Step 4.** Remove the sensors from the flow cell. **NOTE:** It is not necessary to remove the electronics from the sensor.
- Step 5.** Install the vinyl caps on to the sensor tips or place the tips of the removed sensors in a cup of sample water for temporary storage while cleaning the flow cell.

**⚠ Keep the sensor tips wet and the sensors energized.**

- Step 6.** Remove the flow cell from the panel by removing the knurled nuts (Figure 1).
- Step 7.** Remove the remaining hardware from the flow cell. (Figure 2).

**NOTE:** It is recommended that an anti-seizing compound appropriate for the application be used during the reassembling of the flow cell.



- Wash the surfaces with plain or soapy water only.
- Use gentle, liquid dishwashing soap if necessary.
- **DO NOT USE** commercial glass cleaning fluids.
- Use a soft, lint-free cloth.

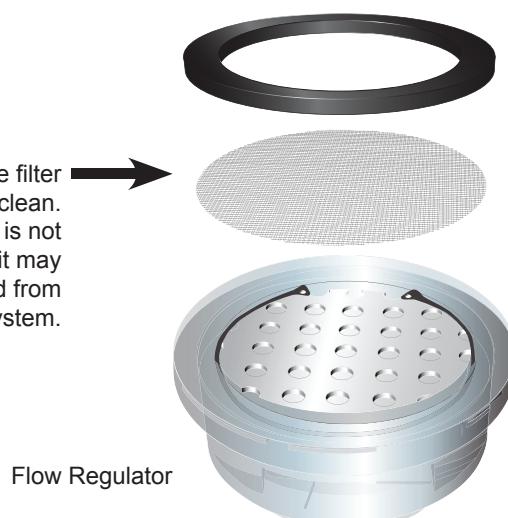
Remove filter screen to clean. If the filter is not desired, it may be removed from the system.

#### Servicing the Flow Regulator and Filter



**WARNING:** Do not disassemble the flow regulator. There are no user serviceable parts inside.

If your inlet pressure is less than 1 bar (15 psi), remove the flow regulator and quick disconnect inlet connector.



Flow Regulator

## O-ring Installation

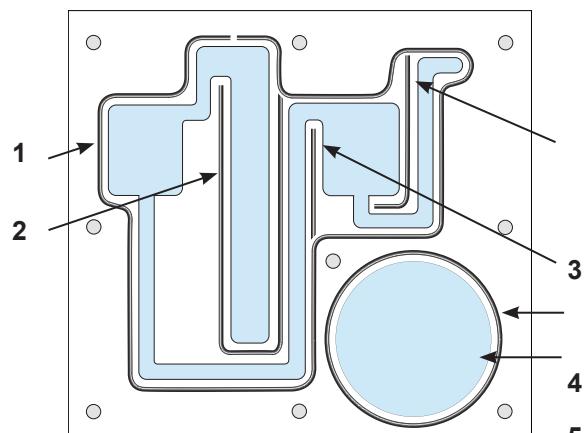


**CAUTION!** The 3-4630.390 (159 001 688) O-ring kit comes complete with two O-rings (5 and 6) and a single cord of material that must be cut and fitted into the O-ring groove of the flow cell (1 and 4).

- The sealing of the flow cell is accomplished by four cut O-ring segments and two round O-rings sealing the flow regulator. Refer to the illustration below for special O-ring fitting instructions. Butt all O-ring joints together so there is no gap.
- Remove the O-rings during flow cell disassembly. Both the O-rings and all sealing grooves should be examined for cleanliness.
- Wipe all surfaces carefully with a soft, lint-free cloth to ensure good sealing.
- The cross section of the O-rings should be round and smooth. If they are flattened, their ability to seal is reduced.
- Do not use liquid or paste sealant.



**Do not scratch the sealing surfaces of the flow cell block. Scratches to the sealing surfaces can cause irreparable leaks.**



Individual O-rings shown.  
Butt all segment joints together in final assembly.

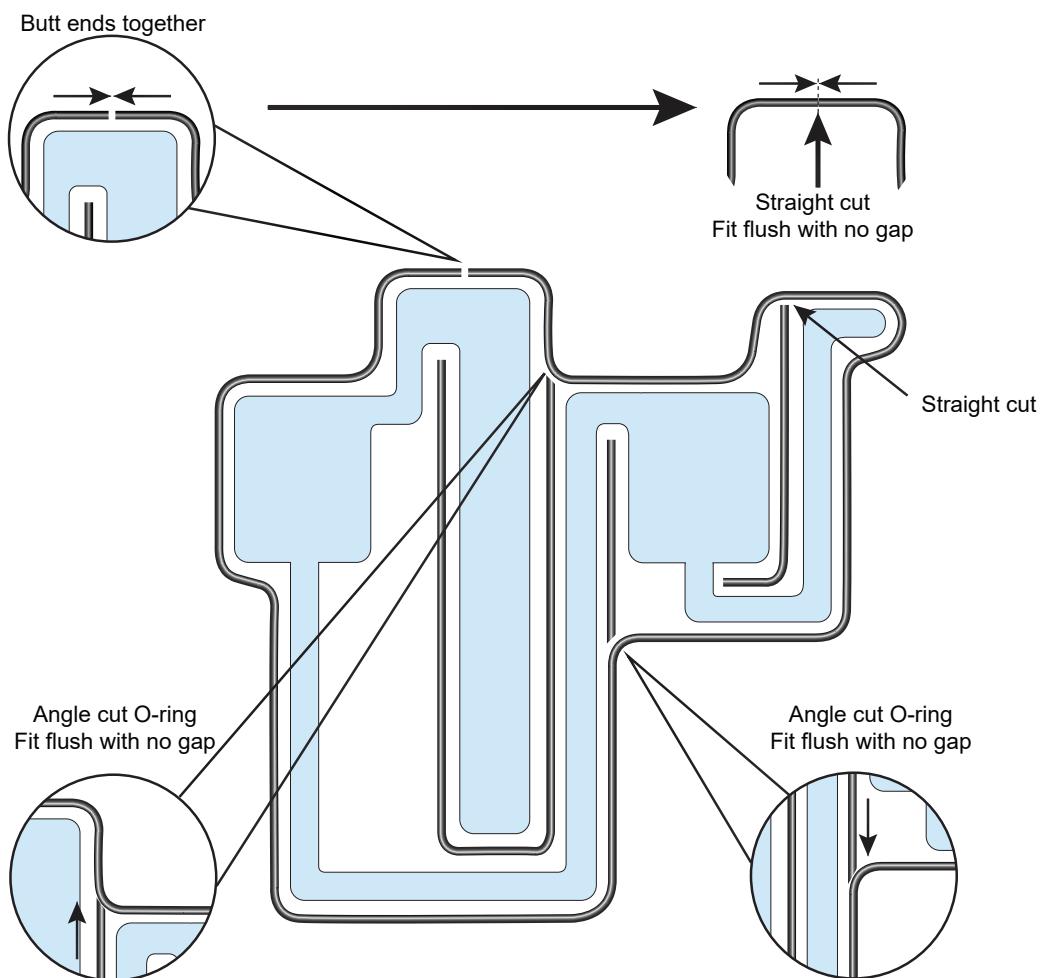


New O-ring cross section



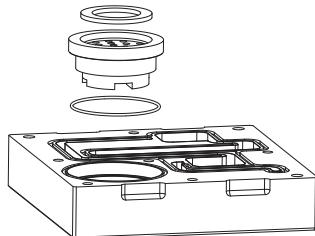
Old flattened O-ring cross section  
(Replace)

**Fit all O-ring joints so there is no gap in final assembly.**

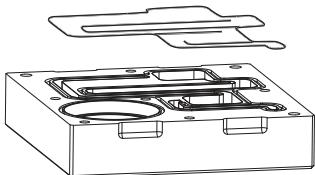


## Flow Cell Assembly

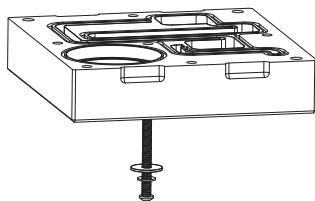
**WARNING!** Do not over tighten flow cell bolts. Maximum torque is 8.1 Nm (72 Lb-In). Over tightening the bolts can damage the flow cell. Do not over-tighten the bolts in an attempt to stop a leak.



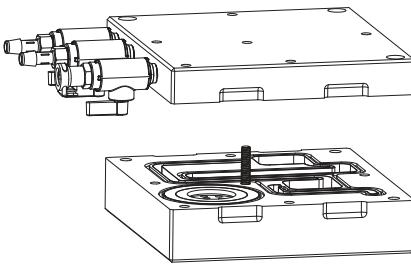
**1** Install the assembled pressure regulator and the two round O-rings into the flow cell.



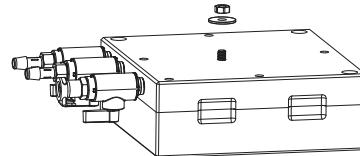
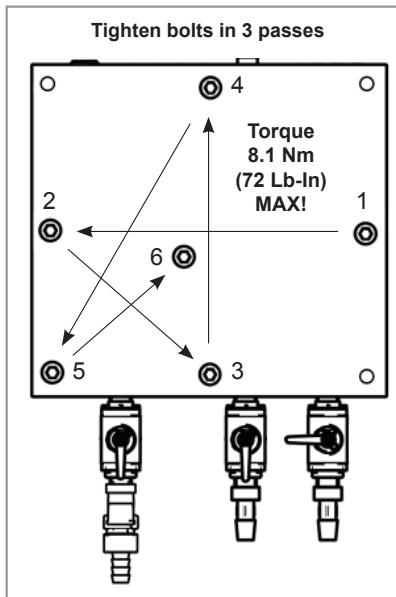
**2** Install the four O-ring segments.



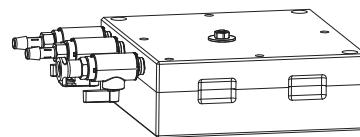
**3** Insert the center bolt into the block.



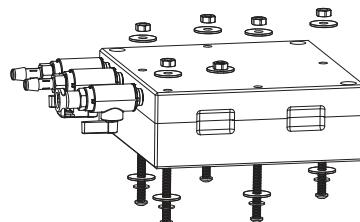
**4** Align and place the back block onto the flow cell. Check to be sure that the O-rings are seated correctly.



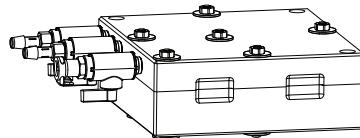
**5** Install the nut and washers.



**6** Tighten the nut just enough to hold the block together and keep the O-rings in place.



**7** Install the remaining bolts, washers and nuts.



**8** Tighten the bolts in three passes to specification.



**9** Install the flow cell on the panel. Screw on the thumb nuts finger tight. **DO NOT** use tools on the thumb nuts.

**NOTE:** It is recommended that an anti-seizing compound appropriate for the application be used during the reassembling of the flow cell.

## Troubleshooting

### 463X Chlorine Analyzer

The troubleshooting table below outlines possible causes and remedies related to the flow cell panel system. Refer to the respective Chlorine Controller and sensor manuals for specific component troubleshooting.

Problem	Possible Cause	Remedies
No water flow	Inlet pressure below 1 bar (15 psi)	Check source pressure. Remove regulator if pressure is < 1 bar/15 psi
	Damaged flow regulator	Replace flow regulator
	Clogged filter	Clean filter or remove pressure regulator if inlet pressure is below 1 bar (15 psi)
	Clogged flow switch	Clean or change flow switch
Low water flow	Clogged filter	Clean filter
	Insufficient inlet pressure	Increase inlet pressure to specification or remove flow regulator
	Damaged flow regulator	Inspect or replace
	Clogged flow switch	Clean or change flow switch
Excessive flow	Excessive pressure over 8 bar (120 psi)	Ensure inlet pressure does not exceed 8 bar (120 psi)
	Damaged flow regulator	Replace flow regulator
Flow cell leaks	Incorrect assembly	Inspect, clean, and reassemble
	Loose bolts	Tighten bolts (8.1 Nm, 72 Lb-In Max)
	Defective or missing O-rings	Replace O-rings
	Damaged sealing surfaces	Replace flow cell
Leaks around sensor	Damaged sensor O-ring	Inspect or replace O-ring
	Damaged flow cell	Inspect flow cell
Water leaks out of top vent hole	Drain valve closed or plugged	Inspect
	Hose connections are backwards	Connect water source correctly
	Outlet drain not below flow cell	Route drain line below flow cell and vented to atmosphere
Algae growth in flow cell	Low chlorine concentration in water	Locate flow cell away from light
	Exposure to light	
Excessive small bubbles in flow cell accumulating on sensors	Water source contains bubbles	Check water source
	Water source is saturated with dissolved gasses	
Chlorine Controller does not turn on	No power or external circuit breaker is switched off	Inspect power and wiring connections
	Loose or incorrect wire connections	Check connections
Chlorine reading too high	Breached membrane	Replace membrane and fill solution
Chlorine reading too low	Electrode needs to be repolished	Polish gold-plated electrode
	Not enough electrolyte	Check electrolyte level
	Low flow rate	Check source pressure
	Filter clogged	Clean the filter
	Sensor conditioning not long enough	Allow the sensor to condition for 4 hours (See 2630 or 2632 sensor manual for details)
Sensor output drifts	Electrode needs to be repolished	Polish gold-plated electrode
	Not enough electrolyte	Check electrolyte level
	Variable flow rate	Check flow rate
	Clogged filter	Clean the filter
	Contaminated fill solution	Change electrolyte fill solution

Chlorine Electrode Troubleshooting (see 2630-X or 2632-1 electrode manual: 3-2630.090)

Chlorine Controller Troubleshooting (see 9950-X manual: 3-9950-XP.090)

pH Electrode Troubleshooting (see 2724 manual: 3-2724.090)

## Troubleshooting

### 9950-X Chlorine Controller

Several factors can cause irregular or incorrect readings. The first thing to check is to verify that the controller and sensors have been installed correctly. The list below outlines possible causes and remedies.

Problem	Possible Cause	Remedies
Chlorine Controller does not turn on.	Incorrect wiring. No or low voltage supplied to transmitter. Blown fuse. Bad wire connections or splices.	Check wiring, power supply and wiring connections.
Display screen is too dark or too dim.	Contrast set incorrectly or ambient temperature is too high.	Adjust contrast in Options Menu.
LCD backlight does not work.	Contrast set to low	Adjust contrast in Options Menu.
Incorrect temperature reading.	Faulty chlorine sensor. Bad sensor connection.	Check connections or replace sensor.
Display or Current output is erratic.	Electrical noise interfering with the measurement. Sensor malfunction.	Ensure system is properly grounded. See Sensor Troubleshooting.
Output is not zero when electrode is placed in non-chlorinated water.	Electrode not properly conditioned. Noise interfering with the measurement. Calibration incorrect.	Condition new sensor for 4 hours. Cap replacement or electrolyte refill: 2 hours. Properly ground system. Replace sensor.
4 to 20 mA output is incorrect.	4 to 20 mA is not scaled same as Loop device. Loop device is not scaled same as sensor.	Re-span loop device to match sensor.

#### Chlorine Sensor Troubleshooting (see 2630 sensor manual)

Incorrect readings	Sensor conditioning time too short.	Run for 4 hours before calibrating.
	Membrane cap damaged or contaminated.	Clean or replace cap.
	Interference from water contaminants.	See Specifications data.
	Low flow rate.	Check flow.
	Air bubbles on membrane.	Install flow cell vertically with upwards flow.
	pH outside working range (See Specifications data).	Check pH.
	Low or no electrolyte in sensor.	Fill sensor with electrolyte.
	Membrane cap loose.	Inspect/tighten (do not use tools).
	Only combined chlorine present when measuring free chlorine.	Validate with DPD test.
	Sensor not making good contact with electronics.	Inspect and reconnect.
	Defective sensor.	Replace.
	No pH compensation being used.	Manually enter pH value in Input Menu or calibrate pH sensor.
	Cl sensor not calibrated.	Calibrate Cl sensor.

## 9950-X Error Messages

The 9950-X error warnings are self-explanatory. An error message can appear under the following circumstances:

- User input value is out of range
- Poor electrical connection
- Sensor is not connected or detected
- Temperature error
- Incorrect sensor type chosen in the Options Menu
- Two calibration points are too close together when calibrating pH or chlorine.

Error Messages	Problem	Possible Cause	Remedies
Calibration Due	Calibration of the electrode is required.	New electrode.	Calibrate the electrode.
		Next calibration reminder.	See Calibration Menu.
Out of Range	Electrode is exceeding range.	Temperature of the sample is > 45 °C (113 °F).	Verify range of the application.
		pH is outside proper level of 5.5 to 8.2.	Replace faulty electrode. Calibrate the electrode.
Error too Large	pH Calibration issue.	pH electrode at the end of life.	Replace the electrode.
		Dirty pH electrode.	Clean and recalibrate electrode.
No pH Value	pH value not appearing.	pH electrode in manual mode.	See Input Menu.
		pH electrode faulty.	Check connection to pH electrode.
Check Preamp	Chlorine or pH electronics not detected.	Electronics not plugged into the proper channel.	Check Chlorine Controller and electronics wiring.
		Wiring incorrect in connector.	Cycle power Off and On.
		Damaged Preamp electronics.	Replace the electronics.
		Chlorine and pH electronics are not inserted into correct channel.	Verify Channel 1 and Channel 2 have the correct electronics.
No Probe	Flashing over Channel.	Chlorine or pH electrode missing.	Remove and reset the electrodes in proper electronics.
	Probe not detected in electronics.	Damaged electrode.	Replace the electrode.

**NOTE:** If the type of chlorine sensor is changed, i.e. Free Chlorine or Chlorine Dioxide, the measurement type on the Input Menu should be changed.

## Troubleshooting

### 2630 Free Chlorine Electrode

### 2632 Chlorine Dioxide Electrode

Chlorine Controller error messages related to calibration are detailed in the 9950-X operation manual.

Problem	Possible Causes	Remedies
Sensor cannot be calibrated. Output is lower than DPD test.	Sensor conditioning time too short	Condition for 4 hours minimum prior to initial calibration
	Chlorine content too low	DPD value must be greater than 0.2 ppm to calibrate
	Low flow rate	Check to make sure flow rate is sufficient
	Air bubbles on electrode membrane	Inspect visually. Tap to remove bubbles. Mount at an angle
	Low or no electrolyte in electrode	Fill electrode with electrolyte
	Organic chlorination agents present in water	See Specifications data
	Surfactants in water	Remove surfactants and replace cap
	Membrane cap coated	Clean or replace membrane cap
	Membrane cap loose	Tighten or replace membrane cap
	pH outside working range.	See Specifications data
Sensor output very low	Electrode needs to be repolished	Polish gold-plated electrode
	Not enough electrolyte	Check electrolyte level
	Sensor conditioning time too short	Condition for 4 hours minimum prior to initial calibration
	Chlorine content too low	Add chlorine to validate
	Only bound chlorine present. No free chlorine	Check for chloramine with appropriate DPD test
Unstable output from sensor	Electrode not making good contact with electronics	Inspect and reconnect
	Electrode needs to be repolished	Polish gold-plated electrode
	Not enough electrolyte	Check electrolyte level
	Air bubbles on electrode membrane	Inspect visually. Tap to remove bubbles. Mount at an angle
	Membrane damaged	Replace membrane. Condition sensor for at least 2 hours and recalibrate.
	Electrode not making good contact with electronics	Inspect and reconnect
	Non-sensor problem	Check 3-2650 Electronics connection to electrode (see 3-2650 manual for instructions). Make sure connections are dry. Check instrument hookup

## Troubleshooting - 2751-7 pH Electronics

Problem	Possible Cause	Remedies
After completing calibration procedure, the output values are inaccurate.	Insufficient time allowed for electrode stabilization during calibration.	Recalibrate, verify that test solutions are at room temperature and wait at least 30 seconds after placing electrode in solution.
Chlorine Controller Troubleshooting (see 9950-X manual: 3-9950-XP.090)		
pH Electrode Troubleshooting (see 2724 manual: 3-2724.090)		

## Specifications

### 9950-X Chlorine Controller

#### General

##### Compatibility:

- Sensors:
  - 3-2630-1 Free Chlorine Sensor 0.02 to 2 ppm
  - 3-2630-2 Free Chlorine Sensor 0.05 to 5 ppm
  - 3-2630-3 Free Chlorine Sensor 0.1 to 20 ppm
  - 3-2632-1 ClO<sub>2</sub> Electrode, 0.02 to 2 ppm
  - 3-2724-00 Flat pH Electrode,  
See FCL and ClO<sub>2</sub> system pH specification
- Electronics:
  - 3-2650-7 Amperometric Electronics
  - 3-2751-7 pH Sensor Electronics

#### Materials:

- Case: PBT
- Panel gasket: Silicone rubber
- Window: Shatter-resistant glass
- Keypad: Silicone rubber
- Display: Backlit alphanumeric dot matrix LCD
- Update rate: 1 second
- Contrast: User selected, 5 levels

#### Performance

##### System Operational Ranges/Limits:

- 3-2630-1: Free Cl: 0.02 to 2 ppm, pH: 5 to 8.5
- 3-2630-2: Free Cl: 0.05 to 5 ppm, pH: 5 to 8.5
- 3-2630-3: Free Cl: 0.1 to 20 ppm, pH: 5 to 8.5
- 3-2632-1: ClO<sub>2</sub>: 0.2 to 2 ppm, pH: 4 to 11
- 3-2724-00: pH: 0 to 14 (8.5 when used with the 4630)

Cl Temp. Range: 0 °C to 45 °C (32 °F to 113 °F)

##### Max. Cable Length:

- Digital (S<sup>3</sup>L): 30 m (100 ft) maximum

#### Electrical

Input Power: 12 to 24 VDC ±10% regulated,  
250 mA max current

Sensor Power: 5 VDC ±1% @ 25 °C, regulated  
(provided by 9950-X)

#### Input Specifications

- One Digital (S<sup>3</sup>L) input from Free Chlorine or Chlorine Dioxide electrode
- One Digital (S<sup>3</sup>L) input from pH electrode

#### Output Specifications:

- Current Loop (4 loops provided)
- 4 to 20 mA, isolated, adjustable span, reversible with minimum and maximum endpoint adjustment.
- Chlorine, Temperature and pH
- Update Rate: 300 ms
- Max Loop impedance: 50 Ω max. @ 12 V  
325 Ω max. @ 18 V  
600 Ω max. @ 24 V

#### Relay Module:

- 2 mechanical SPDT contacts with adjustable hysteresis and programmable High, Low, Off or Proportional and 4 binary inputs
- May be disabled if not used
- Max. voltage rating: 5 A @ 30 VDC  
5 A @ 250 VAC, resistive load
- Time delay: Programmable from 0 to 99999 s

#### Environmental Requirements

- Operating Temperature: -25 °C to 120 °C (-13 °F to 248 °F)  
(transmitter only)
- Storage Temperature: -15 °C to 80 °C (5 °F to 176 °F)
- Relative Humidity: 0 to 95%, non-condensing
- Maximum Altitude: 4000 m (13,123 ft)
- Enclosure: NEMA 4X

#### Standards and Approvals

- CE, UL, CUL, WEEE
- RoHS Compliant
- Manufactured under ISO 9001, ISO 14001 and ISO 45001
- China RoHS (Go to [www.gfps.com](http://www.gfps.com) for details)

#### Declaration of Conformity according to FCC Part 15

 This device complies with Part 15 of the FCC rules. Operation is subject to the following two conditions:  
(1) This device may not cause harmful interference, and,  
(2) This device must accept any interference received, including interference that may cause undesired operation.

## Specifications

### 2650 DryLoc Amperometric Electronics

#### General

##### Compatibility:

- Sensors: All GF Amperometric DryLoc Sensors
- Instruments: GF 9950-X Chlorine Controller

##### Mounting:

DryLoc connection

##### Materials:

PBT

##### Cable:

4.6 m (15 ft) 3 conductor shielded, 22 AWG

- Max. Length: 30 m (100 ft)

#### Performance

- Accuracy: < 5 nA or 1% of reading, whichever is greater @ 25 °C over full input range
- Temperature: ± 1.0 °C (PT1000) over full operation range (when calibrated at ambient temperature)
- Update Rate: 500 ms
- Range: ± 450 nA
- Resolution: 0.1 nA

#### Electrical

##### Input Specifications:

- Sensor: Raw signal
- Temperature: PT1000 RTD

##### Output Specifications:

- Digital (S<sup>3</sup>L): Serial ASCII, TTL level 9600 bps

#### Power Supply Input:

- Digital (S<sup>3</sup>L): 5 to 6.5 V ± 10%, 3 mA max (from the 9950-X)

#### Environmental

- Storage Temp.: -20 °C to 50 °C (-4 °F to 120 °F)
- Operating Temp.: 0 °C to 85 °C (32 °F to 185 °F) (electronics only)
- Relative Humidity: 0 to 95%, non-condensing (no electrode connected)
- Enclosure: NEMA 4X/IP65 with electrode installed
- Shipping Weight: 0.64 kg (1.41 lb)

#### Standards and Approvals

- CE, WEEE
- RoHS Compliant
- Manufactured under ISO 9001, ISO 14001 and ISO 45001
- China RoHS (Go to [www.gfps.com](http://www.gfps.com) for details)

#### Declaration of Conformity according to FCC Part 15

 This device complies with Part 15 of the FCC rules.

Operation is subject to the following two conditions:

- (1) This device may not cause harmful interference, and,
- (2) This device must accept any interference received, including interference that may cause undesired operation.

### 2751-7 pH Electronics

#### General

##### Compatibility:

- Electrode: GF 2724-00 Flat pH Electrode
- Instrument: GF 9950-X Chlorine Controller

##### Mounting:

DryLoc connection

##### Materials:

PBT

##### Cable:

4.6 m (15 ft) 3 conductor shielded, 22 AWG

#### Performance

- Accuracy: ± 0.03 pH @ 25 °C
- Resolution: 0.02 pH
- Response Time (includes electrode response): < 6 s for 95% of change
- Range: 0.00 to 14.00 pH (8.2 when used with the 4630)
- Resolution: 0.02 pH

#### Electrical

##### Input Specifications:

- Input Impedance: >10<sup>11</sup> Ω
- Temperature Drift: ± 0.002 pH per °C
- Input Resolution: 0.02 pH, 0.3 °C

##### Output Specifications:

- Digital (S<sup>3</sup>L): Serial ASCII, TTL level 9600 bps

#### Power Supply Input:

- Digital (S<sup>3</sup>L): 5 to 6.5 V ± 10%, 3 mA max (from the 9950-X)

#### Environmental

- Storage Temp.: -20 °C to 50 °C (-4 °F to 120 °F)
- Operating Temp. (Electronics Only): 0 °C to 85 °C (32 °F to 185 °F)
- Relative Humidity: 0 to 95%, non-condensing
- Enclosure: NEMA 4X/IP65 with electrode installed
- Shipping Weight: 0.64 kg (1.41 lb)

#### Standards and Approvals

- CE, WEEE
- RoHS Compliant
- Manufactured under ISO 9001, ISO 14001 and ISO 45001
- China RoHS (Go to [www.gfps.com](http://www.gfps.com) for details)

#### Declaration of Conformity according to FCC Part 15

 This device complies with Part 15 of the FCC rules.

Operation is subject to the following two conditions:

- (1) This device may not cause harmful interference, and,
- (2) This device must accept any interference received, including interference that may cause undesired operation.



## Specifications

### 2724 DryLoc pH Electrode

#### General

Compatibility: ..... GF 2751-7 pH/ORP Sensor electronics

Process Connection ..... 3/4 in. NPT or ISO 7/1 R 3/4 threads or GF flow fittings

Wetted Materials ..... PPS, glass, UHMWPE, FKM

#### Performance

Efficiency ..... >97% @ 25 °C (77 °F)  
Efficiency indicates the "wellness" of a new electrode. Efficiency is measured by comparing the actual slope (mV/pH) at 25 °C to the theoretical output of 59.16 mV/pH. An efficiency of 97% to 100% is equivalent to a slope of 57.39 to 59.16 mV/pH.

Range ..... Free Chlorine 5.5 to 8.2 pH  
Chlorine dioxide 4.0 to 11 pH

#### Environmental

Pressure

Operating ..... -10 °C to 65 °C (14 °F to 149°F), 0 to 6.9 bar (0 to 100 psi)  
65 °C to 85 °C (149 °F to 185°F), Linearity derated 6.9 to 4.0 bar (100 to 58 psi)

Temperature

Storage ..... 0 °C to 50 °C (32 °F to 120 °F).  
**CAUTION:** The electrode glass will be shattered if shipped or stored at temperatures below 0 °C (32 °F). The performance life of the electrode will be shortened if stored at temperatures above 50 °C (120 °F).

Operating ..... -10 °C to 85 °C (14 °F to 185 °F)

Rel. Humidity ..... 0 to 95% indoor/outdoor non-condensing to rated ambient

Shipping Weight ..... 0.25 kg (0.55 lb)

#### Standards and Approvals

- CE, WEEE
- RoHS Compliant
- Manufactured under ISO 9001, ISO 14001 and ISO 45001

 China RoHS (Go to [www.gfps.com](http://www.gfps.com) for details)

#### Declaration of Conformity according to FCC Part 15

This device complies with Part 15 of the FCC rules.

Operation is subject to the following two conditions:

- (1) This device may not cause harmful interference, and,
- (2) This device must accept any interference received, including interference that may cause undesired operation.

## Ordering Information

### 463X Chlorine Analyzer

Mfr. Part No.	Code	Description
3-4630-13	159 001 949	Chlorine panel, free chlorine sensor (0.02 to 2 ppm) w/ sensor electronics, pH sensor w/ electronics, DC power input
3-4630-14	159 001 996	Chlorine panel, free chlorine sensor (0.02 to 2 ppm) w/ sensor electronics, pH sensor w/ electronics, AC power input
3-4630-23	159 001 950	Chlorine panel, free chlorine sensor (0.05 to 5 ppm) w/ sensor electronics, pH sensor w/ electronics DC power input
3-4630-24	159 001 997	Chlorine panel, free chlorine sensor (0.05 to 5 ppm) w/ sensor electronics, pH sensor w/ electronics, AC power input
3-4630-33	159 001 951	Chlorine panel, free chlorine sensor (0.01 to 20 ppm) w/ sensor electronics, pH sensor w/ electronics DC power input
3-4630-34	159 001 998	Chlorine panel, free chlorine sensor (0.01 to 20 ppm) w/ sensor electronics, pH sensor w/ electronics AC power input
3-4632-12	159 001 952	Chlorine panel, chlorine dioxide sensor (0.02 to 2 ppm), with sensor electronics, no pH sensor
3-4632-13	159 001 958	Chlorine panel, chlorine dioxide sensor (0.02 to 2 ppm), with sensor electronics, pH sensor w/ electronics

## Ordering Information

### Accessories and Replacement Parts

3-9950-3	159 001 954	Chlorine Controller, DC power input
3-9950-4	159 001 955	Chlorine Controller, AC power input
3-9950-5	159 001 956	Chlorine Monitor, no Relay or Output modules
3-9950.395-M	159 001 905	Modbus Module
3-2630-1	159 001 746	Free Chlorine electrode, 0.02 to 2 ppm (mg/L)
3-2630-2	159 001 662	Free Chlorine electrode, 0.05 to 5 ppm (mg/L)
3-2630-3	159 001 747	Free Chlorine electrode, 0.01 to 20 ppm (mg/L)
3-2632-1	159 001 767	Chlorine Dioxide electrode, 0.02 to 2 ppm (mg/L)
3-2724-00	159 001 545	pH electrode, Flat Glass, Pt1000 Temp Element, $\frac{3}{4}$ in. MNPT
3-2751-7	159 001 957	pH - Inline Electronics, Digital (S <sup>3</sup> L), 4.6 m (15 ft) cable
3-2650-7	159 001 670	Chlorine - In-line Amperometric Electronics, digital (S3L), 4.6 m (15 ft) cable
3-4630.390	159 001 688	Rebuild kit, O-rings, boots, screws, 1 filter screen
3-4630.391	159 001 689	Pressure regulator with 1 spare filter screen
3-4630.392	159 001 690	Acrylic flow cell complete with all components and connections
3-4630.393	159 310 162	Flow Switch Kit, PP *
3-4630.395	159 001 960	Flow Switch Kit **
3-2630.391	159 001 674	Electrolyte Kit, 30 ml bottle with syringe and needle
3-2632.391	159 310 160	Chlorine Dioxide electrolyte, 30 mL (2)
3-2630.394	159 310 164	Free Chlorine and Chlorine Dioxide Replacement PTFE membrane (1)
3-2630.398	159 310 166	Free Chlorine Sensor maintenance kit - (2) electrolyte, (2) PTFE membranes, (2) Silicone Bands, and Polishing Paper
3-2632.398	159 310 165	Chlorine Dioxide maintenance kit - (2) electrolyte, (2) PTFE membranes, (2) Silicone Bands, and Polishing Paper
1220-0021	159 801 182	O-ring FKM
3-0700.390	198 864 403	pH Buffer Kit (1 each 4, 7, 10 pH buffer in powder form, makes 50 mL of each)
3822-7004	159 001 581	pH 4.01 buffer solution, 1 pint (473 mL) bottle
3822-7007	159 001 582	pH 7.00 buffer solution, 1 pint (473 mL) bottle
3822-7010	159 001 583	pH 10.00 buffer solution, 1 pint (473 mL) bottle
3-2700.395	159 001 605	Calibration kit: included 3 polypropylene cups, box used as cup stand, 1 pint pH 4.01, 1 pint pH 7.00
3-2759	159 000 762	pH/ORP System Tester (adapter cable sold separately)
3-2759.391	159 000 764	2759 DryLoc Adapter Cable (for use with 2751-7)
3800-5000	159 838 107	3.0M KCl Storage Solution for pH and ORP, 1 pint (473 ml) bottle
3-2700.397	159 001 870	Protective Cap for pH/ORP electrodes, 5 pieces
3-2700.398	159 001 886	Lubricant Kit

\* Default wiring for production units prior to February 2022

\*\* Default wiring for production units after February 2022

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