Model FX-CL-F/T
Reagentless Amperometric
Free or Total Chlorine
Residual Analyzer
Instruction Manual

Document No. OMFXCLFT042018.1

Table of Contents

Table of Contents

Section1 General Information

Every effort has been made to ensure the accuracy of this document at the time of printing. In accordance with the company's policy of continuous product improvement, Foxcroft reserves the right to make product changes and changes in this manual at any time without notice or obligation.
No liability is accepted for any direct, indirect, special, incidental or consequential damages resulting from any defect or omission in this manual.

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1.1 Safety Information

CAUTION: You must read and follow the sensor precautions before attempting to start up the analyzer to prevent damage to the sensor.

Please read this entire manual before unpacking, setting up, or operating this equipment.

Pay attention to all danger and caution statements. Failure to do so could result in serious injury to the operator or damage to the equipment.

Do not use or install this equipment in any manner other than that specified in this manual.

Be certain the unit is disconnected from the power source before attempting to service or remove any component.

HELPFUL IDENTIFIERS

In addition to information on installation and operation, this instruction manual contains WARNINGS pertaining to user safety, CAUTIONS regarding possible instrument malfunction, and NOTES on important useful operating guidelines.

1.2 Precautionary Labels

	This symbol indicates a device sensitive to Electro-Static Discharge and indicates that care must be taken to prevent damage to the device
 WARNING	This symbol and word indicates that possible personal injury may occur if the precautionary measures are not carried out
CAUTION	Alerts you to the possibility of instrument damage or malfunction
NOTE	Alerts you to important operating information

Section 1.3 System Description, Limitations

You must read and follow the sensor precautions before attempting to start up the analyzer to prevent damage to the sensor.

The Foxcroft model FX-CL-F and FX-CL-T both use a membrane covered amperometric sensor to continuously monitor and control free or total residual chlorine without any reagents or moving parts. The difference between the two models is the type of sensor used and corresponding measurement it produces, free or total chlorine. The analyzer interface is the same for both sensor types except for the available operating ranges for each sensor type.

The measurement system does not alter the sample and does not add chemicals to the sample stream.

The model FX-CL-F/T is intended to sample process water that has been treated to US EPA National Secondary Drinking Water Standards or swimming pool quality standards only. Wastewater that has undergone tertiary treatment may be possible to monitor if final water product is at or near drinking water standards.

For the measuring methods used here, chlorine diffuses through the membrane from the measurement medium and, combined with the electrolytes, triggers an electrical signal at the working electrode. This signal is proportional to the concentration of chlorine and is amplified by the electronics. The measurement signal is independent of the temperature of the media due to an integrated temperature compensation.

pH has an effect on chlorine measurement accuracy since the sensor measures only the hypochlorous acid (HOCl) form of chlorine, and not the hypochlorite ion (OCl^-) form of chlorine. The ratio of these two different types of chlorine varies with the pH value of the analyte. This behavior is described by the hypochlorous acid dissociation curve. In the 3-electrode sensor there is a linear loss of slope, or decrease in residual value, of about 5% for every 1 pH unit increase after pH 7. In the 2-electrode sensor there is a 65% loss of slope at pH 8.

The sensor is not intended or recommended to measure or ensure the absence of chlorine.

The sensor is not suitable for determining organic chlorination agents such as cyanuric acid based products.

The sensor cannot distinguish between various species of chloramines.

The analyzer requires a constant and consistent sample flow at no more than atmospheric pressure as well as a waste drain.

The monitoring of reservoirs, basins or tanks requires a pump to deliver sample to the analyzer at the required pressure and flow rate. Intermittent operation is possible within certain time limitations.

Residual measurements are determined and output continuously, the analyzer does not use a sample and hold method for residual determination.

The microprocessor based electronics are designed with additional capacity to accept both software and hardware upgrades so that the analyzer can be converted over time into a multi-function and multi-parameter measurement system.

Section 1.4 Sensor Precautions

You must read and follow the sensor precautions before attempting to start up the analyzer to prevent damage to the sensor.

NOTE: Using the sensor without mounting it in the supplied flow cell will lead to incorrect measurement results; it cannot simply be submerged in a pipe, basin, channel or tank.

CAUTION: The sensor must be always be supplied with voltage when connected to the analyzer and installed in the flow cell, even when online measurements are not being produced and transmitted. Failure to do so will damage the sensor and void the warranty. If no chlorine is to be measured for over 24 hours the sensor must be disconnected from the analyzer, the membrane cap emptied, rinsed and the sensor stored per instructions.

CAUTION: The membrane is extremely sensitive to pressure. Screwing the membrane cap on and off without exposing the vent hole will rupture the membrane due to overpressure or under pressure in the cap and make the sensor inoperable. Follow the instructions closely for filling the membrane cap with electrolyte.

The membranes can be damaged by high pressure**.** The sensors should be operated under as little pressure as possible, with the measurement media able to flow freely. If this is not possible, the sensors can be operated under a constant pressure of up to 1 bar (relative pressure) or 2 bar (absolute pressure). Fluctuations in pressure must be avoided.

The membrane cap must only be filled and fully screwed onto the sensor immediately before inserting it into the flow cell to prevent salt or gel deposits on the inside surface of the membrane.

Touching and contaminating the electrode finger can damage it, making the sensor unusable.

The measurement media must not contain hydrophobic substances (e.g. oil or grease), which can damage the membrane cap.

The measurement media must not contain surfactants (surface-active substances e.g. from detergents, cleaning agents or disinfectants).

The presence of air bubbles in the measurement medium in front of the membrane may produce incorrect measurement results.

If there is no chlorine in the measurement medium for more than 24 hours this will lead to incorrect measurement results due to biofilm deposits on the membrane. You should avoid operating the sensors with measurement medium which does not contain chlorine. After operation in a chlorine-free medium, a settling time period is required before valid measurements can resume.

Using the sensors to measure media containing other oxidants in addition to chlorine, reducing agents or corrosion protection agents may lead to incorrect measurement results. Refer to the specifications for each sensor for interfering oxidants and substances.

Section 1.4 Sensor Precautions

Sensors are intended for clean drinking or industrial process water applications only, with quality similar to drinking and swimming pool water. Consider "Clean water" as being filtered and treated to US EPA National Secondary Drinking Water Standards as follows:

Contaminant	Secondary MCL
Aluminum	0.05 to 0.2 mg/L
Chloride	250 mg/L
Color	15 color units
Copper	1.0 mg/L
Corrosivity	Non-corrosive
Fluoride	2.0 mg/L
Foaming agents	0.5 mg/L
Iron	0.3 mg/L
Manganese	0.05 mg/L
pH	6.5 - 8.5
Silver	0.1 mg/L
Sulfate	250 mg/L
Total Dissolved Solids (TDS)	500 mg/L
Zinc	5 mg/L
Turbidity	not to exceed 5 NTU
NO CORROSION INHIBITORS PERMITTED	

Section 1.5 Total Chlorine Sensor Description

3-Electrode Total Chlorine Sensor Description & Operation

This membrane-covered, amperometric sensor is used to measure the total chlorine concentration in water.

The sensor detects "free chlorine" liberated from organic chlorination products (chlorine gas, hypochlorite, etc.) and "bound chlorine", for example chloramines. It cannot distinguish between various forms of chloramines.

This sensor can only be used in media similar in quality to drinking or swimming pool water. Typical applications include the monitoring of filtered, treated drinking water and swimming pools. **NOTE:** Iron and manganese levels above USEPA Secondary Drinking Water Standards MCL will prevent the operation of the 3-electrode chlorine sensor.

The sensor is not suitable for detecting the absence of chlorine.

This sensor has a 3-electrode measuring system. Three electrode sensors work on the potentiostatic principle. The reference and counter electrode are separated. The working electrode is membrane-covered. Together with the reference electrode, it is located in an electrolyte chamber that contains a special pH buffered electrolyte and is separated from the process medium. The potential of the reference electrode is especially constant due to its high resistance. The current flows through the counter electrode. The sensor is loop powered. This loop power is generated by the analyzer electronics and supplied through the cable that transmits the residual signal.

The working electrode (cathode) is made of gold (Au) while the reference electrode is made of silver/silver chloride (Ag/AgCl). The counter electrode is made of stainless steel.

In this measurement method the chlorine diffuses out of the process medium and through the selective membrane, inducing an electrical signal in combination with the electrolyte on the working electrode. The signal, which is proportional to the concentration of chlorine, is amplified by the electronics. Due to an integrated temperature compensation system, the measurement signal is independent of the medium temperature.

Section 1.6 Free Chlorine Sensor Description

2 & 3-Electrode Free Chlorine Sensor Description

The 2 or 3-electrode membrane-covered, amperometric sensors are used to measure the concentration of free chlorine in drinking and swimming pool water, industrial, process and cooling water.

The following inorganic chlorinating agents can be measured with the sensor for free chlorine: chlorine gas (Cl2), electrolytically generated chlorine, sodium hypochlorite (NaOCl, chlorine bleach lye), calcium hypochlorite (Ca(OCl)2) or chlorinated lime (Ca(OCl)Cl).

The sensors are not suitable for detecting the absence of free chlorine.

The integrated electronics of the sensors provides a temperature-compensated current signal of 4 to 20 mA.

3-Electrode Free Chlorine Sensor
The sensor for free chlorine with reduced pH dependency is a potentiostatic 3-electrode sensor with a micro porous, hydrophilic (moisture attracting) membrane and special electrolyte.

The 3-electrode sensor can only be used in water of drinking or swimming pool water quality. Solid materials in the media clog up the membrane and prevent the sensors from working correctly. **NOTE:** Iron and manganese levels above USEPA Secondary Drinking Water Standards MCL will prevent the operation of the 3-electrode chlorine sensor.

Suitable chlorinating agents that can be measure include inorganic chlorine compounds such as chlorine gas (Cl2), chlorine produced by membrane electrolysis (not suitable: chlorine electrolysis without a membrane), sodium hypochlorite (NaOCl), calcium hypochlorite (Ca(OCl)2) and chlorinated lime CaCl(OCl).

The measured variable is the free chlorine (including "(iso)cyanuric acid chlorine") independent of the (iso)cyanuric acid concentration. Combined chlorine (chloramine) is not measured. The sensor is not suitable for determining organic chlorination agents such as cyanuric acid based products.

This membrane type allows both hypochlorous acid and hypochlorite from the water to be measured to reach the electrode chamber through the membrane. A buffered electrolyte sets a specific ratio of HOCl and OCl^- here.

The membrane also allows the flow of ions from the electrolyte into the water, which eventually causes the electrolyte to be unable to function. A measured medium containing tensides (detergents, surfactants) may lead to an accelerated exchange between the electrolyte and the medium. The decision whether a membrane can operate in a medium containing tensides can only be made on a case by case basis.

The working electrode is made of gold, the high-impedance reference electrode of silver/silver halide and the current carrying counter electrode of stainless steel.

With the 3-electrode system, the selectivity is increased by the improved stability of the potential: the system consists of the measuring or working electrode (ME), the counter electrode (CE) and a reference electrode (RE). The potential between ME and RE is maintained at the value required for the flow-through reaction by means of a potentiostatic switching arrangement. The RE does not carry any current. The current flows via the CE. Again, in the case of the 3-electrode system, the diffusion-controlled limiting current is proportional to the concentration of the analyte.

No zero adjustment is required. The electrode chamber contains a defined electrolyte, with which the sensor does not exhibit a zero signal. Therefore, no zero adjustment using analyte-free water is required.

Section 1.6 Free Chlorine Sensor Description

3-Electrode Free Chlorine Sensor

As there must be an electrical connection between the counter electrode and the measurement medium, the measurement medium must have a minimum conductivity of approx. 10 µ S/cm. This means that the sensors are not suitable for use in highly-purified water, or similar.

2-Electrode Free Chlorine Sensor Description

The sensor for free chlorine is a potentiostatic 2-electrode sensor with a micro porous, Hydrophobic (moisture repellent) PTFE membrane and special electrolyte.

Suitable chlorinating agents that can be measure include inorganic chlorine compounds such as chlorine gas (Cl_2), electrolytically generated chlorine, sodium hypochlorite (NaOCl), calcium hypochlorite ($Ca(OCl)_2$), chlorinate lime CaCl(OCl). The sensor is not suitable for determining organic chlorination agents such as cyanuric acid based products or combined chlorine.

The sensors are not suitable for detecting the absence of free chlorine.

The 2-electrode sensor can only be used in water of drinking or swimming pool water quality. Solid materials in the media clog up the membrane and prevent the sensors from working correctly.

If the membrane comes into contact with tensides (detergents, surfactants) from washing, cleaning or disinfecting agents, the hydrophobic properties of the membrane are lost, the membrane becomes permeable, and therefore damaged. For this reason, contact with these substances must be strictly avoided.

The membrane does not allow hypochlorite anions to penetrate the membrane to reach the electrolyte chamber; so, the sensor does not measure OCl^-, only hypochlorous acid.

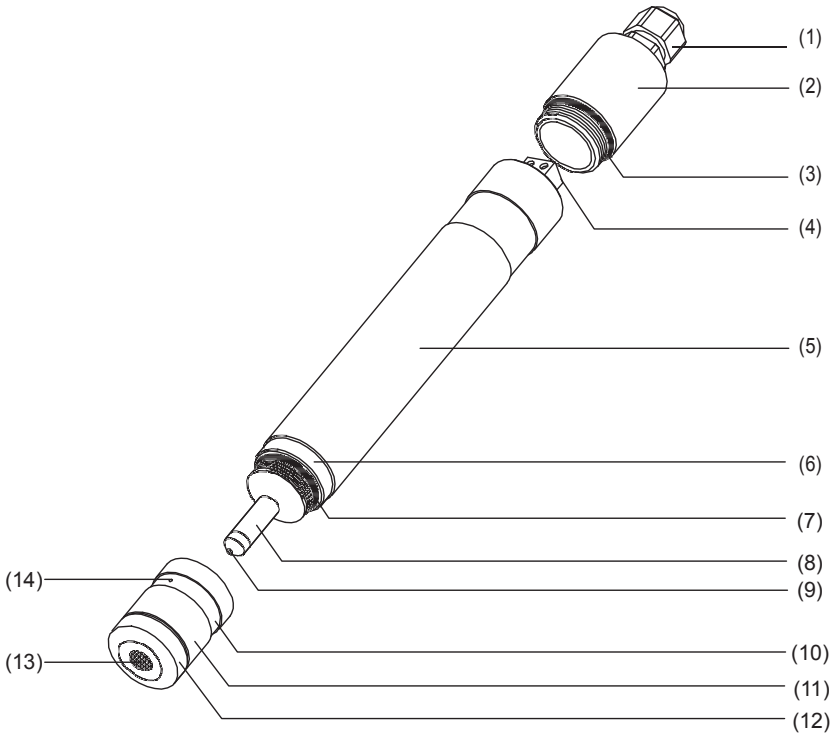
The *working electrode* (cathode) is made of gold (Au). The anode, which performs the function of *a combined reference and counter electrode,* is made of silver (Ag), and is provided with a coating of silver chloride (AgCl).

A 2-electrode system has the disadvantage that the potential between ME and CE can vary. This applies particularly in an open system, as the conditions at the electrodes can vary here, as a result of fluctuations in the composition of the water. If the potential does vary, then other oxidizing agents contained in the water having a polarization voltage in a similar range, can also react and distort the result.

No zero adjustment is required. The electrode chamber contains a defined electrolyte, with which the sensor does not exhibit a zero signal. Therefore, no zero adjustment using analyte-free water is required.

Section 1.8 Assembly Diagram, 3-Electrode Sensors

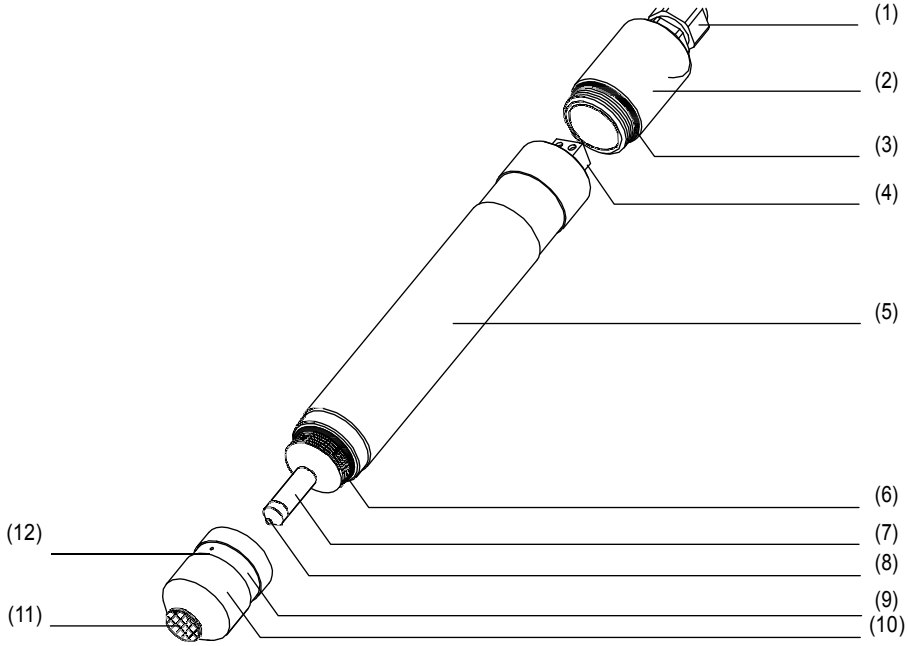
Details Total Chlorine Sensor and 3-Electrode Free Chlorine Sensor



(1) Cable gland nut
(2) Terminal Cover
(3) O-ring
(4) 2-pin terminal for measuring cable connection
(5) Electrode shaft with integrated electronics
(6) Counter electrode (stainless steel)
(7) O-ring
(8) Electrode finger (reference electrode)
(9) Measurement electrode
(10) Transparent vent seal
(11) Membrane cap
(12) Membrane holder (stainless steel)
(13) Membrane
(14) Vent hole

Section 1.9 Assembly Diagram, 2-Electrode Sensor

Details 2-Electrode Free Chlorine Sensor



(1) Cable gland nut
(2) Terminal Cover
(3) O-ring
(4) 2-pin terminal for measuring cable connection
(5) Electrode shaft with integrated electronics
(6) O-ring
(7) Electrode finger (reference electrode)
(8) Measurement electrode
(9) Transparent vent seal
(10) Membrane cap
(11) PTFE membrane
(12) Vent hole

Section 1.10 Specifications, Total Chlorine Sensor

Specifications, Total Chlorine Sensor

Analyte	Total chlorine
Membrane type	Hydrophilic membrane
Measuring cable connection	2-pin terminal, polyamide PG7 screw connection; wire cross section 2x 0.25mm^2, cable diameter approx. 4 mm
Voltage supply	U_B 12 to 30 V DC (electrical isolation recommended)
Electromagnetic compatibility	According to EN 61326-1 Interference emission: Class B Interference immunity: To industrial requirements
Output signal	4 to 20 mA
Settling time	2 hours
Incident flow velocity	Approx. 15cm/s or 30L/hr (8 GPH)
Measuring ranges	0 to 0.5 mg / l (ppm) 0 to 2 mg / l (ppm) 0 to 5 mg / l (ppm) 0 to 10 mg / l (ppm) 0 to 20 mg / l (ppm)
Response time t_{90}	About 2 min
Operating temperatures / temperature compensation	+5 to +45 °C
Zero point adjustment	Not required
pH value operating range	4 to 12 pH
pH dependency (loss of slope)	Linear decrease of approx. 5 % per each upward pH unit (starting from pH 7)
Disruptive substances / cross sensitivity	Chlorine dioxide, Ozone. Calcium deposits. Iron interferes with electrode function and must not exceed USEPA MCL
Pressure resistance	p_{abs} max. 2 bar p_{rel} max. 1 bar No pressure fluctuations are admissible when operating under pressure. We recommend unpressurized operation (atmospheric pressure).
Material	Shaft, cover, cap: PVC Membrane disk holder: stainless steel
Dimensions	Diameter: 25mm, length: 220mm
Weight	about 125g
Maintenance	Check the measurement signal: regularly, at least once a week Replace the membrane cap: once a year (subject to water quality) Change the electrolyte: every 3 to 6 months
Storage	Sensor: frost-free, dry and without electrolyte, can be stored for an unlimited time at +5 to +45 °C Electrolyte: In the original bottle and protected against sunlight at +5 to +25 °C

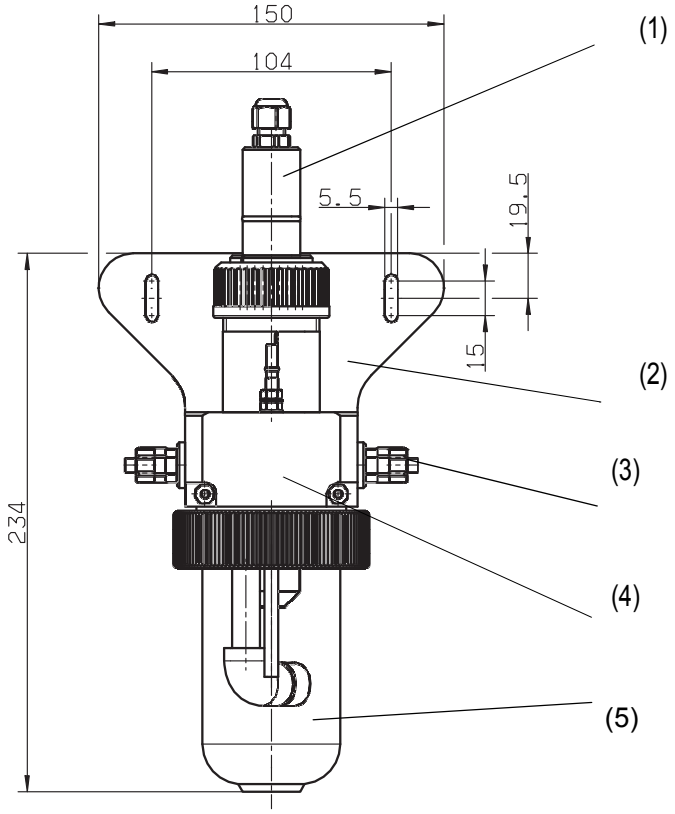
Section 1.11 Specifications, Free Chlorine Sensors

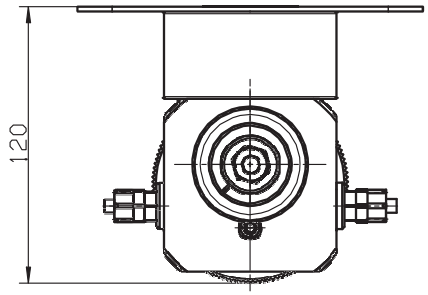
Free Chlorine Sensor Data, 2 -Electrode & 3-Electrode with Reduced pH Dependence

Analyte	**Free chlorine, 2-electrode**	**Free chlorine, 3-electrode reduced pH dependence**
Membrane type	Hydrophobic PTFE membrane	Hydrophilic membrane
Measuring cable connection	2-pin terminal, polyamide PG7 screw connection; wire cross section 2x 0.25mm^2, cable diameter approx. 4 mm	
Suitable chlorination agents	Inorganic chlorine compounds: NaOCl (sodium hypochlorite), Ca(OCl)2, chlorine gas, chlorine produced by membrane electrolysis (not suitable: chlorine electrolysis without a membrane)	
Voltage supply	UB 12 to 30 V DC (electrical isolation recommended)	
Electromagnetic compatibility	According to EN 61326-1 Interference emission: Class B Interference immunity: To industrial requirements	
Output signal	4 to 20 mA	
Settling time	1 hour	2 hours
Incident flow velocity	Approx. 15cm/s or 30L/hr (8 GPH)	
Measuring ranges mg / l (ppm)	0.05 to 0.5 0.05 to 2 0.05 to 5 0.05 to10 0.05 to 20 0.05 to 50 0.05-100, 0.05 to 200	0.05 to 2 0.05 to 5 0.05 to10 0.05 to 20 0.05 to 200
Resolution	0.01 mg/l for 0.5,2,5,10,20 mg/l 0.1 mg/l for 50, 100, 200 mg/l	0.01 mg/l for 2,5,10,20 mg/l 0.1 mg/l for 50, 100, 200 mg/l
Response time t_{90}	About 30 sec.	About 2 min
Operating temperatures / temperature compensation	+5 to +45 °C	
Zero point adjustment	Not required	
pH value operating range	6.0 to 8 pH	4 to 9 pH
pH dependency (loss of slope)	No loss from pH 5-7, at pH 8 about 65%, at pH9 about 90%	No loss from pH 5-7, at pH 8 about 10%, at pH9 about 20%
Disruptive substances / cross sensitivity	Chlorine dioxide, Ozone, Combined Chlorine, reducing agents, corrosion protection agents, Calcium deposits.	Chlorine dioxide, Ozone, Combined Chlorine. Calcium, Iron over USEPA MCL prevents electrode function. Corrosion inhibitors
Min. Sample Conductivity	50µS / cm (not suitable for highly purified water)	
Pressure resistance	p_{abs} max. 2 bar p_{rel} max. 1 bar No pressure fluctuations are admissible when operating under pressure. We recommend unpressurized operation (atmospheric pressure).	
Material	Shaft, cover, cap: PVC	Shaft, cover, cap: PVC, Membrane disk holder: stainless steel
Dimensions & Weight	Diameter: 25mm, length: 220mm, Weight about 125 g	
Maintenance	Check the measurement signal: regularly, at least once a week Replace the membrane cap: once a year (subject to water quality) Change the electrolyte: every 3 to 6 months	
Storage	Sensor: frost-free, dry and without electrolyte, can be stored for an unlimited time at +5 to +45 °C Electrolyte: In the original bottle and protected against sunlight at +5 to +25 °C	

Section 1.12 Flow Cell Assembly

The flow cell (part no. 303500) is fastened to a wall or mounting panel with mounting bracket (part no. 303501)

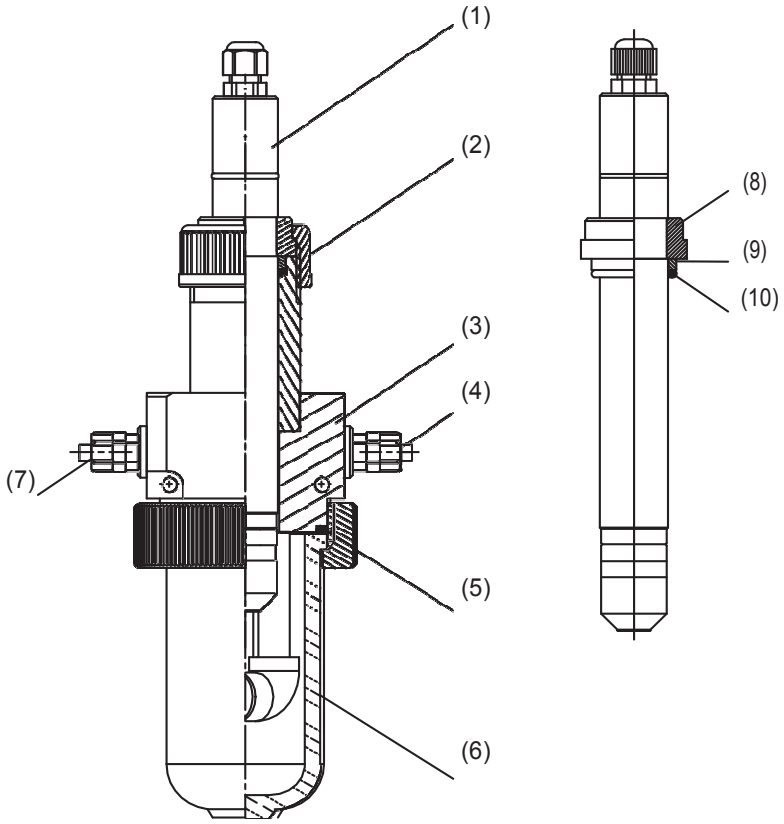




(1) Sensor
(2) Mounting bracket (303501)
(3) Connection G1/4 for hose ø 8mm x 6mm
(4) Flow cell housing
(5) Removable inspection glass

Section 1.13 Sensor & Flow Cell Assembly

Overview



(1) Sensor
(2) Union nut
(3) Flow Cell
(4) Outlet G1/4A or DN10
(5) O-ring, inspection glass
(6) Inspection glass
(7) Inlet G1/4A or DN10
(8) Stepped collar 1"[1]
(9) Compression ring[1]
(10) O-ring, stepped collar[1]

[1] Part of the flow cell.

Caution: *When assembling and installing the sensor (1) make certain the O- rings and threads are clean and undamaged*

The transparent inspection glass (6) can be unscrewed from the fitting housing for cleaning.

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1. First push the O-ring (10) onto the sensor (1), then the compression ring (9) and over it the 1" stepped collar (8) (starting from the Pg screw connection). The stepped collar (8) must engage in the groove.
2. After the sensor has been prepared in this manner, insert it into the flow cell (3) and fasten it in place with the union nut (2).

Section 2.0 Membrane Cap Removal, Filling With Electrolyte

Screwing the membrane cap off and on

CAUTION:
The electrolyte will come out of the valve opening when the membrane cap is screwed on. Wear safety goggles and gloves.
Wash off electrolyte (an aqueous solution of an alkali halide) under flowing water.

CAUTION:

- NEVER SCREW THE MEMBRANE CAP ON OR OFF WITHOUT FIRST MOVING THE VENT SEAL AWAY FROM THE VENT HOLE. NOT DOING SO WILL CAUSE A VACUUM OR EXCESS PRESSURE AND DESTROY THE MEMBRANE.
- DO NOT TOUCH THE BOTTOM OF THE MEMBRANE CAP. DO NOT TOUCH THE ELECTRODE FINGER OR GET IT DIRTY.

Potential damage to the membrane cap

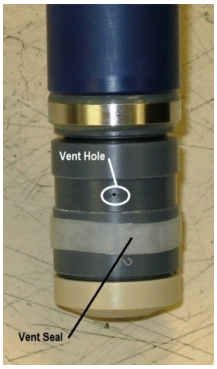
CAUTION:

- Do not unscrew the stainless steel membrane disc holder from the membrane cap, this will cause the membrane to be misaligned and damage it.
- The steps must be performed exactly as they are described below.

NOTE!
In order for the sensor to function correctly, the membrane must be **fully** screwed onto the sensor. The first screw-in resistance is the sealing O-ring. The membrane cap must be screwed on further until it comes into contact with the sensor shaft.

Filling membrane cap with electrolyte

1. Put on protective gloves for handling electrolyte which can irritate the skin.
2. Use a small screwdriver or similar tool to raise the vent seal covering the vent hole and push it down out of the groove to open the vent hole circled.



3. Screw the membrane cap off the shaft of the sensor.

4. Discard the used electrolyte, clean the membrane cap with clean water and then dry it.

Section 2.0 Membrane Cap Removal, Filling With Electrolyte

Filling membrane cap with electrolyte

5. To avoid forming bubbles do not shake the electrolyte. Make sure the vent hole is open. Tilt the electrolyte bottle as shown to minimize bubbles and fill the membrane cap up to the brim with electrolyte, if needed tap to eliminate bubbles.

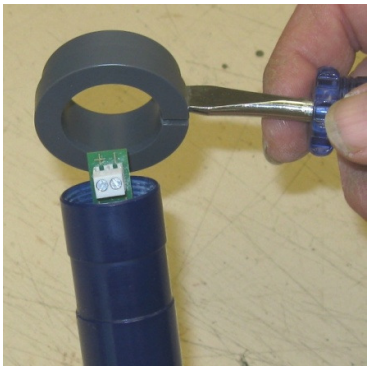
Do not cover the vent hole with a finger when installing the membrane cap to prevent electrolyte from leaking, doing so will create excessive pressure that will destroy the membrane.

6. Holding the shaft of the sensor vertically (do not hold the membrane cap by covering the vent hole), slowly screw on the filled membrane cap. You will feel resistance when the cap reaches the O-ring, continue tightening until the cap touches the electrode shaft. Excess electrolyte will overflow from the cap, and when almost completely tightened it will escape from the open vent hole. Be sure the cap is screwed on tightly against the sensor shaft.

Section 2.1 Assemble the Sensor

7. After tightening the membrane cap, slide the vent seal up into the groove, so that it covers the vent hole. Rub around the vent seal to remove any bubbles or voids. If liquid leaks through the membrane, the membrane is faulty and you must use a new membrane cap.

8. Take the stepped collar, smaller diameter up, and insert a screwdriver into the split to enlarge the opening.



9. Push the stepped collar down until it snaps into position in the sensor shaft groove.

10. Slide compression ring and O-ring onto the sensor shaft in the order shown.

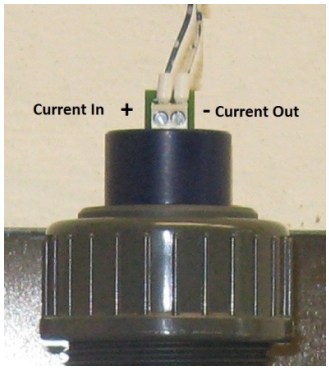
11. Push the ring and O-ring up against the stepped collar.

Section 2.2 Sensor Installation

Install the Sensor

12. Insert the sensor into the flow cell with the wiring terminals facing you. Slide the union nut over the sensor and tighten onto the flow cell.

13. Slide the cable gland nut and terminal cover over the sensor cable in the order shown. The cable shrink wrap should protrude through the cable gland nut.



14. There are two possible sensor cable colors. Attach the blue with white dots (or black) sensor cable to the positive terminal of the sensor. Attach the white with blue dots (or white) sensor cable to the negative terminal of the sensor.

Section 2.3 Sensor Conditioning

Assemble the Sensor

15. Screw the terminal cover onto the sensor and then tighten the cable gland nut.

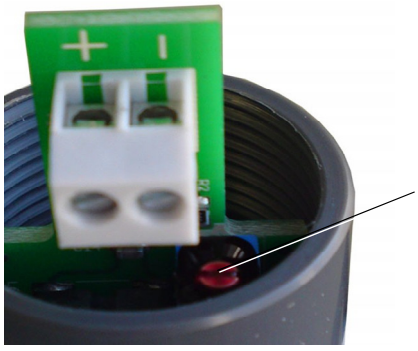
16. The solution ground pin on the front of the flow cell is normally not needed, it may be used if you find a solution ground is necessary.

Sensor Conditioning Time

The sensor will not provide a constant value until after a conditioning time of 2 hours has passed. It cannot be calibrated until then.

The calibration procedure should be repeated on the day after initial commissioning.

On the chlorine sensor, the screw coated with thread locking paint must not be adjusted. If the thread locking paint is damaged claims under the warranty will not be honored.

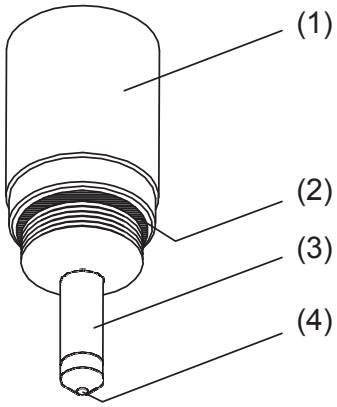


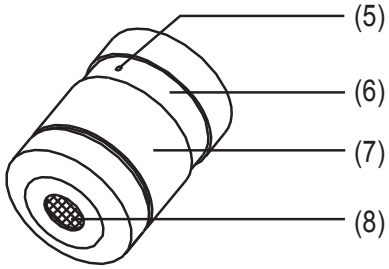
Section 2.4 Cleaning The Electrode Finger Tip

CAUTION: Potential damage to the sensor

Cleaning the electrode finger (3,4) incorrectly may damage the sensor.

- Do not sand the brown coating on the combined counter and reference electrode (3).
- Do not touch or contaminate the electrode finger (3,4).
- Carry out the following steps exactly as they are described.





1. Make sure the vent seal is pushed down and the vent hole is open, unscrew the membrane cap from the shaft of the sensor.
2. Clean the electrode finger and membrane cap with distilled water and dry.
3. Using the special abrasive paper, clean only the tip of the dried electrode finger. To do this place the special abrasive paper on a paper towel with the matte side facing up, hold one corner firmly in place and while holding the sensor vertically, move the electrode tip two or three times over the special abrasive paper. **DO NOT PRESS DOWN ON THE SENSOR, USE ONLY THE WEIGHT OF THE SENSOR TO APPLY PRESSURE OR YOU WILL REMOVE THE ELECTRODE COATING AND DESTROY THE SENSOR TIP.**

4. If necessary use a new membrane cap.
5. Fill the membrane cap up to the brim with enclosed electrolyte ensuring there are no bubbles. With the vent hole open screw the membrane cap onto the sensor.
6. Replace the vent hole seal.

Section 2.5 Sensor Maintenance, Storage

Note:

The service life of the electrolyte is 3 to 6 months. The service life of the membrane depends on the water quality.

If the sensor still indicates values that are too low after the electrode finger tip has been cleaned, a new membrane cap must be used.

Remove calcium deposits or scale that has accumulated on the membrane cap

1. Unscrew the membrane cap from the shaft of the sensor. See "Screwing the membrane cap off and on".
2. Flush away the electrolyte.
3. Place the membrane cap in a 1% solution of hydrochloric acid for a few hours.
4. Before commissioning rinse off with distilled water.
5. Screw the membrane cap filled with electrolyte onto the shaft of the sensor.

Storage/transport

You must store the sensor if it will not be used for monitoring for over 24 hours

1. Unscrew the membrane cap from the shaft of the sensor see "Screwing the membrane cap off and on".
2. Flush away the electrolyte.
3. Rinse off the membrane cap and electrode finger with distilled water and dry with a dust free cloth.
4. Screw the dry membrane cap loosely onto the electrode shaft. The membrane must not be resting against the electrode tip.

NOTE:

Used membrane caps that have been in operation for longer than 1 day cannot be reused!

Placing in operation again

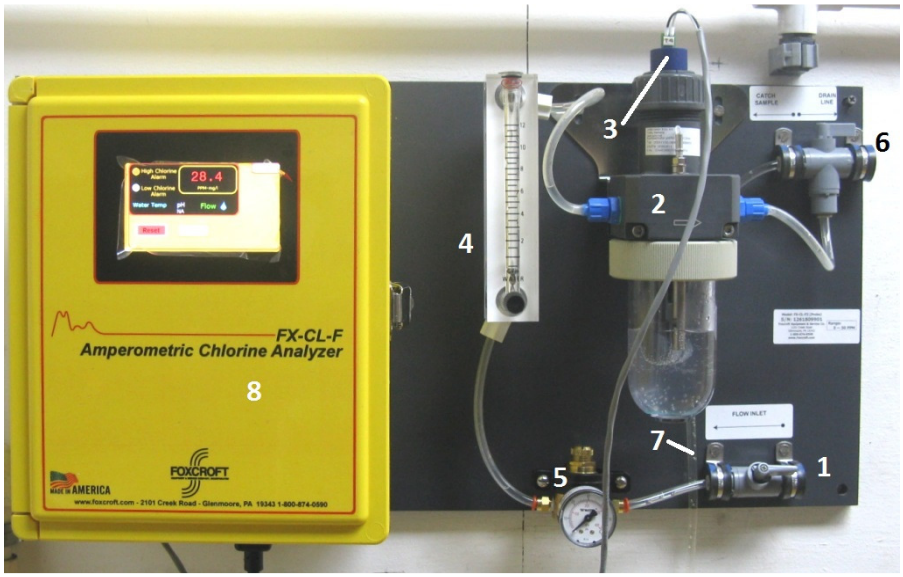
5. Clean the electrode tip with the enclosed special abrasive paper, see "Cleaning the electrode finger tip / replacing the membrane cap and electrolyte".
6. Fill the membrane cap with electrolyte that is free of air bubbles.
7. Use a new membrane cap.

Section 3.0 Model FX-CL-F/T Specifications

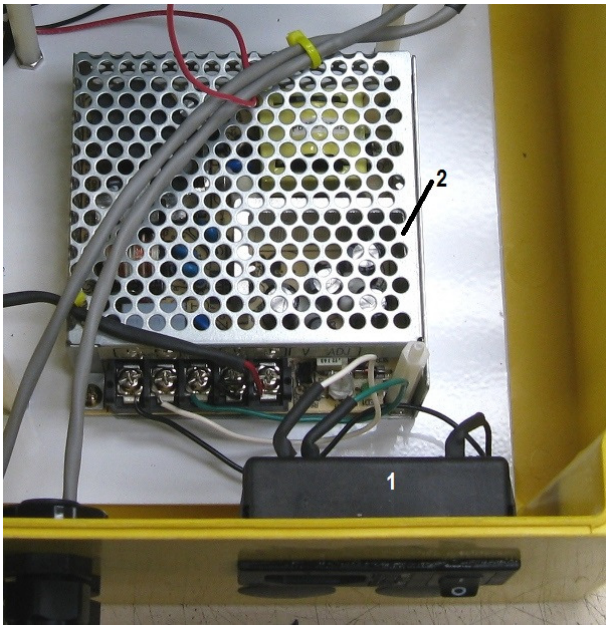
General	
Product Description	Amperometric reagentless total chlorine residual analyzer
Intended Use	Continuous monitoring and control of chlorine residual prior to dechlorination
Measurement Method	Amperometric potentiostatic membrane covered 3-electrode
Parameters Measured	Total (combined) residual chlorine
Available Operating Ranges	0-0.5 mg/l to 0-20 mg/l (ppm)
Temperature Compensation	Standard, +5 to +45°C
Mechanical	
Dimensions	15.25" W x 12.468" H x 6" D, bottle bracket 6.75" dia.
Weight Approx.	15 lbs.
Enclosure & Ingress Protection	Wall mount molded fiberglass, UV resistant, NEMA 4X, IP65 Equivalent
Ambient Temperature and Humidity	+5 to +45°C; 0-95% relative humidity, non-condensing
Electrical	
Conduit Openings	2
Operating Power & Consumption	24 VDC; less than 3 watts
Power Supply	Switching 88-264 Volts AC, 50/60 Hz. Input. Single phase. 24 VDC 2.2A, 52.8W
Power Input Connection	External 6A fused module, IEC 320-C14 connector, with SPST switch, 2 meter detachable cord with IEC 60320 C13 & NEMA 5-15P connectors
Input Fuse	6 amp, 125V, fast acting, 5 x 20 mm glass tube, Designed to UL/CSA 248-14
Electronics	Microprocessor based
Touch Screen Display / Interface	4.3" resistive full color LCD, LED backlight, 65,356 colors, screen resolution 480 x 272, 4MB flash memory, rated min. 1 million touches on any one point
Inputs	(4) Digital, (4) 4-20mA
Signal Output (non isolated)	4-20mA DC 750 ohm max load, (1) residual, up to (4) optionally
Serial Output (non isolated)	(1) RS485 serial port, non-isolated, inactive
Relays	1-amp single pole form C, (3) standard for high & low chlorine; no flow alarms. Up to (8) available optionally. Each relay with red LED energized indicator
Sample Requirements	
Sample Supply	Continuous consistent flow, electrodes must be kept wet, under power and exposed to chlorine
Flow Rate	30L/hr (8 GPH)
Sample Pressure	5 psig, 15 psig maximum
Sample Temperature	+5 to +45 °C
Sample pH Range	4 to 12 pH, Linear slope decrease with approx. 5 % per upward pH unit (starting from pH 7)
Mechanical	
Mounting Panel Dimensions	1/2" x 12" x 24"
Analyzer Enclosure	9" Wide x 12" High x 6" Deep
Weight with Mounting Panel	19 lbs

Section 3.1 Analyzer Component Identification & Description

Reagentless Chlorine Analyzer on Flow Panel

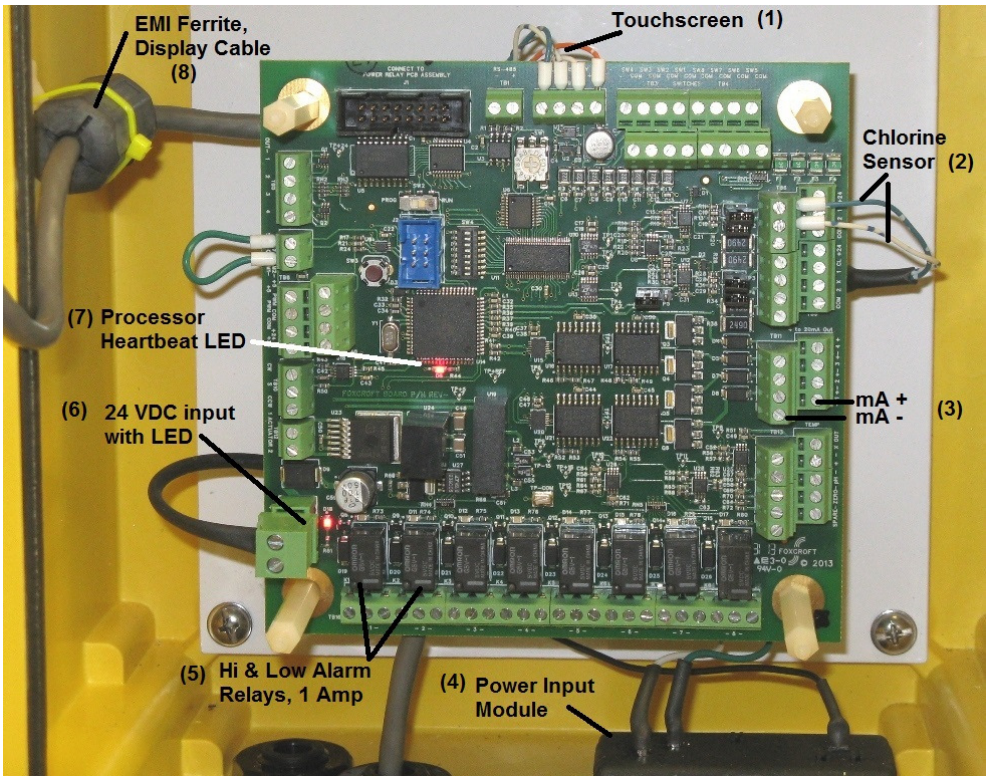


1	Sample inlet, 2-way ball valve
2	Flow Cell
3	Sensor
4	Flow meter with valve, 12 GPH
5	Pressure regulator with gauge
6	Drain tubing
7	Sample tap tubing
8	Analyzer electronics



1	5 Amp fused power input module
2	24VDC power supply, 88-264 Volts AC, 50/60 Hz. Input

3.2 Main Circuit Board Component Identification



1	Touch screen display connection
2	Chlorine sensor connection
3	mA output (only one output is active)
4	Power input module
	Power supply (under main circuit board, not shown, see previous page)
5	1Amp Hi & Low chlorine alarm relays, each with red LED indicator
6	24VDC Power input connector & red LED indicator
7	Processor flashing heartbeat red LED indicator
8	EMI ferrite for display cable

CAUTION: the printed circuit board is sensitive to Electro-Static Discharge. It can be irreparably damaged by static electricity, causing partial or total operational failure. You must take the following precautions before touching or making any connections to the circuit board:

- Before touching the circuit board touch an earth grounded metal surface such as the analyzer's power supply guard, a metal pipe or conduit to discharge any static electricity from your body.
- Wear an anti-static wrist strap connected to an earth ground.

ALWAYS OPERATE THE ANALYZER WITH THE INTERNAL COVERPLATE IN PLACE

Section 4 Installation

4.1 Sample Point Selection Guidelines

General Considerations

The sample must be taken at a point after the chlorine has been thoroughly mixed and has had time to react completely with the process water. A sample point that is too close to the chorine injection point will deliver a sample that is not mixed adequately or has not had sufficient time to complete the chemical reaction, thereby producing inaccurate readings. The supplied 3-ft long sample tubing may be cut to minimize distance.

The analyzer requires a continuous sample flow 30 liters per hour (8 GPH) at no more than atmospheric 15 psig pressure and a drain for sample waste. A pressure regulator and flow control valve upstream of the sample flow cell inlet is required.

Considerations for Control:

For residual control purposes the lag time between chemical injection and detection by the analyzer should be as short as possible, no more than 10 minutes. Longer lag times will result in a continuous cycle of over and under feeding the disinfectant.

Sample Line

The sample line should be run with 3/8” diameter rigid PVC tubing to minimize lag time between the process and analyzer. If a long sample line run is unavoidable, increase the flow rate to the analyzer to about 10-ft/sec. to reduce the sample transport time and then throttle down..

When connecting the sample line into a larger process pipe, use corrosion resistant fittings only. The sample tap should be installed into the center of the pipe from either the top or side to minimize the chance of introducing air bubbles or sediment into the analyzer.

A submersible pump is required to sample from a reservoir or basin.

Filters are not recommended as the trapped material will develop a chlorine demand, resulting in the analyzer measuring a residual that is lower than is present in the process. Some applications may require a PVC flushing wye strainer to remove particulates from the sample.

In low residual applications biological growth can occur in the sample line, which will reduce the residual before it reaches the analyzer. Regular disinfection is required in such applications.

Sample Flow Consistency

Consistent flow and pressure is critical to accurate measurement. A change in flow rate during operation of a calibrated analyzer will require a recalibration of the analyzer.

Section 4 Installation

4.2 Unpacking

Inspect the equipment and packing materials for signs of shipping damage. If there is any evidence of damage, notify the transit carrier immediately.

After unpacking, it is recommended to save the shipping carton and packing materials in case the instrument must be stored or re-shipped.

The shipping container holds the following:

1-FX-CL-F/T Amperometric Chlorine Analyzer
1- Chlorine sensor with 100ml bottle of electrolyte and abrasive cloth
1-Measuring cell
1 -Sample Tubing 8mm OD x 6mm ID x 5’ long, clear flexible PVC tubing
1- Sample Drain Tubing 8mm OD x 6mm ID x 5’ long, clear flexible PVC tubing
1- Grab Sample Tubing 8mm OD x 6mm ID x 3’ long, clear flexible PVC tubing
1- Set of Four Mounting Feet with Four Screws
1- Power cable, 2-meter long with IEC 60320 C13 & NEMA 5-15P connectors
1- Instruction Manual
Panel mounted analyzers will include a 1/2” x 12” x 24” PVC panel to which the following is mounted, wired and plumbed: chlorine analyzer, flow cell, sample input ball valve, pressure regulator with gauge, 12 GPH flow meter, 3-way grab sample valve, sample and drain tubing. No mounting feet included.

2.3 Serial Number & Software Version Number

The FX-CL-F/T chlorine analyzer is shipped with two serial number labels found on the bottom right side of the enclosure, and on the inside of the enclosure door. The labels include the factory calibrated chlorine residual range. Should technical assistance be required, refer to the serial number to identify your system.

The serial number and software version number can also be found on the "Settings" main screen. This number is required if technical support service is needed.

2.4 Locating the Analyzer

The FX-CL/T Amperometric Reagentless Chlorine Analyzer is designed to be mounted indoors on a vertical wall or panel. Mount in a location that is:

- Within ambient temperature and humidity limits (41-113°F, +5 to +45°C), 95% relative humidity or less, non-condensing
- Out of direct sunlight and away from any heat source
- Protected from direct contact with water, rain, snow, ice, or dust.
- Protected from corrosive fluids
- An area that is not subject to vibration
- As close to the sample point as possible to minimize sample lag time
- Accessible for viewing and maintenance

If the analyzer must be located outdoors it must be mounted in a separate enclosure that provides protection from direct sunlight and excessive temperatures, direct contact with water, rain, snow, ice, or dust.

Section 4.5 Wall Mounting, Plumbing

Wall mounting the analyzer

Locate at approximate shoulder height for convenience. The FX-CL-F/T should be level from side to side and front to back.

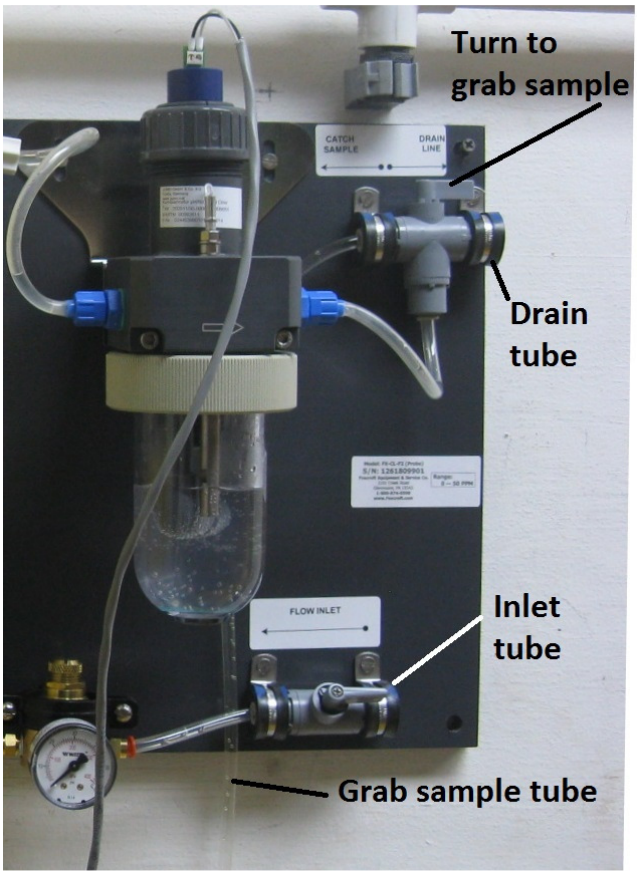
1. Attach the four mounting feet to the rear of the electronics enclosure using the included 5/16"-18 x 1/2" flat head screws.
2. Anchor securely to the wall or panel. The analyzer on mounting panel weighs 19 pounds

Plumbing Connection

1. Connect the supplied 1/4” ID x 3/8” OD x 3’ long, clear flexible PVC sample hose to the existing plumbing. Cut if necessary to keep the sample line as short as possible.

2. Route the supplied 1/4” ID x 3/8” OD x 3’ long, clear flexible drain tubing as needed.

3. If needed cut the grab sample tap tubing to desired length.



Section 4 Electrical Installation

4.1 Electrostatic Warning

CAUTION: the printed circuit board is sensitive to Electro-Static Discharge. It can be irreparably damaged by static electricity, causing partial or total operational failure. You must take the following precautions before touching or making any connections to the circuit board:

- Before touching the circuit board touch an earth grounded metal surface such as the analyzer's power supply guard, a metal pipe or conduit to discharge any static electricity from your body.
- Wear an anti-static wrist strap connected to an earth ground.

5.2 Power Connection

The FX-CL-F/T chlorine analyzer uses a universal switching power supply and can be connected to 100-260 Volts AC, 50/60 Hz. single phase power anywhere in the world. The power supply converts the line voltage to the analyzer's operating voltage of 24VDC.

The analyzer includes a 6 amp fused power input module that is pre-wired to the power supply at the factory so that no direct power input field wiring to the power supply is required. The analyzer is supplied with a 2 meter long power cord with IEC #60320 C13 and NEMA 5-15P connectors. The power input module has an IEC male inlet to accept an IEC #60320 C13 connector.

1. Install a 15 amp circuit breaker to disconnect the analyzer from the main power supply if regulations require.

2. Install a NEMA 5-15 type B grounded socket or a grounded socket to meet local electrical codes for international installations.

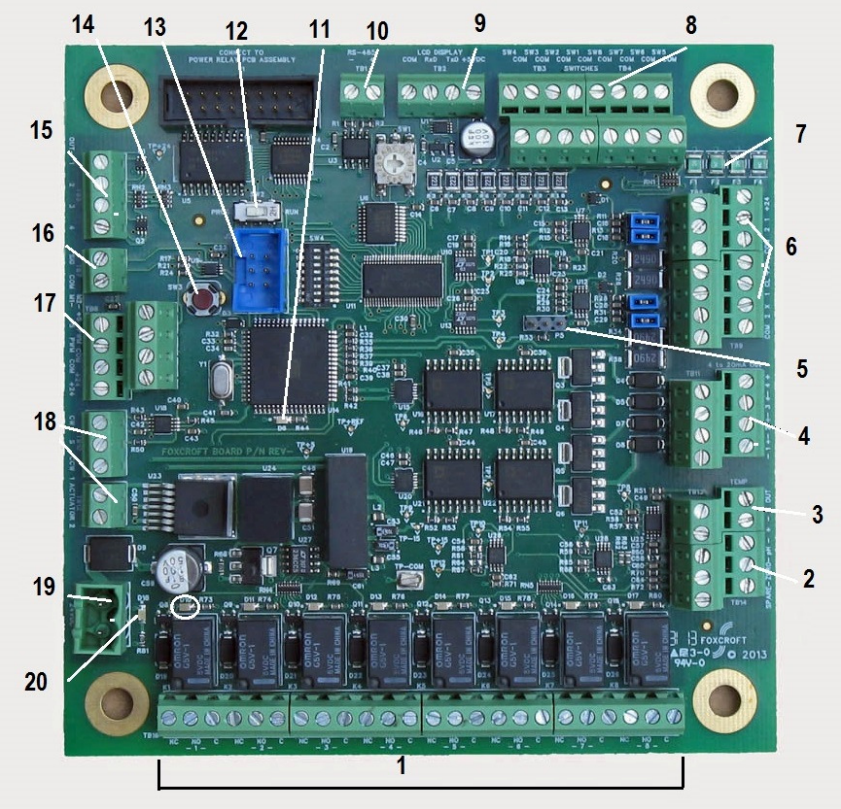
3. Plug the power cord into the inlet on the analyzer and then into the wall socket. **CAUTION: DO NOT BYPASS THE POWER ENTRY MODULE BY CONNECTING DIRECTLY TO THE POWER SUPPLY. DOING SO WILL VOID THE WARRANTY.**

NOTE:
All electrical connections should comply with the National Electrical Code (NEC) and all local regulations.

Do not run power and signal wires together in the same conduit.

Section 5 Electrical Installation

5.3 Circuit Board Layout and Identification

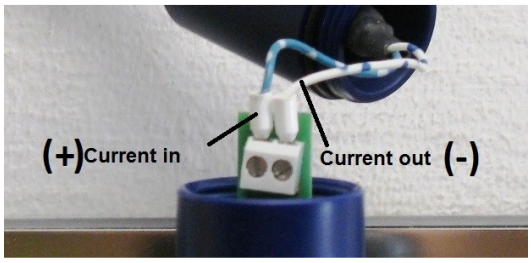


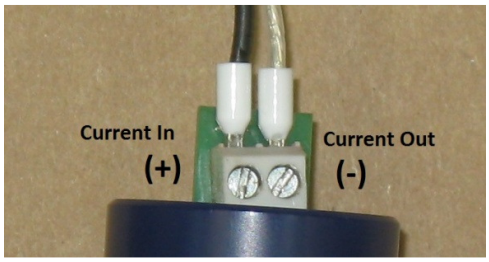
1	1A Relays NO / NC, with LED circled	11	Processor "heartbeat" flashing LED indicator
2	pH input	12	Program / Run switch, factory use only
3	Temperature input	13	Programming input connector, factory use only
4	4-20mA outputs, 1 active	14	Reset switch, factory use only
5	Jumper, Free / Total chlorine sensor, factory use only	15	Motor start / stop
6	Chlorine sensor inputs	16	Flow switch input
7	Fuses, non-replaceable	17	Motor PWM
8	Switch inputs	18	Reserved for FX-8D gas flow control valve
9	LCD display input	19	Power input
10	RS485 output (inactive)	20	Power “On” indicator LED

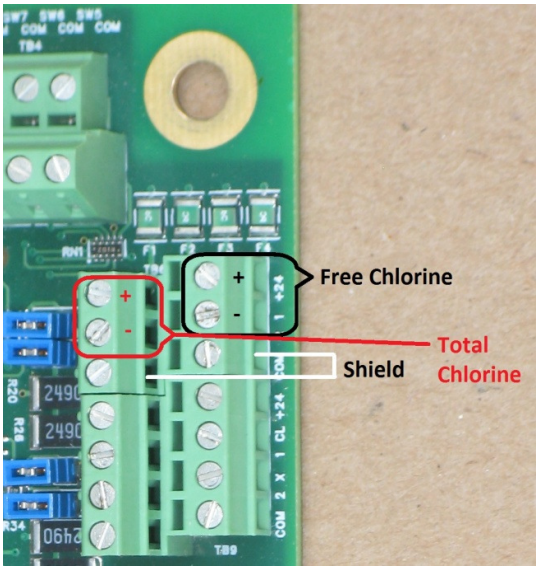
Section 5.4 Factory Default Wiring

5.41Chlorine Sensor Input

+ Blue with white dots **or Black**	TB9 +24
- White with blue dots **or White**	TB9 1
Shield (clear)	TB9 COM

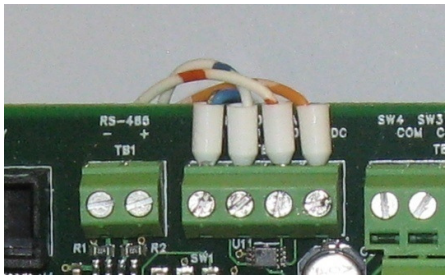






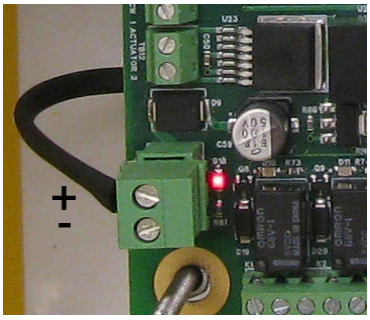
5.42 Display Wiring

Blue (-)	TB2-4
White Blue Dots	TB2-3
White Red Dots	TB2-2
Orange (+)	TB2-1

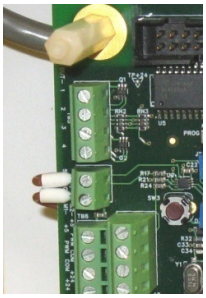


5.43 Power Input

+ 24V	TB-2
- Gnd	TB-1



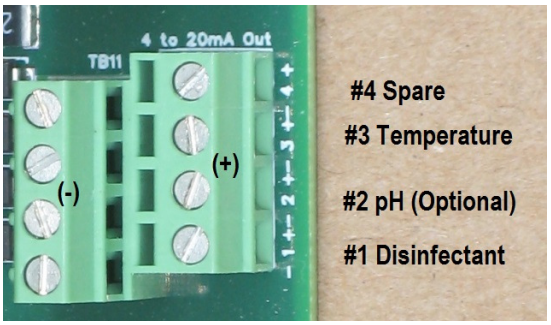
Flow Message Jumper Only



5.4 Factory Default Wiring

5.44 Current Output Wiring

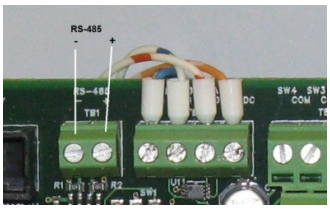
Disinfectant (+)	TB11-1
Disinfectant (-)	TB11-5
pH (+)	TB11-2
pH (-)	TB11-6
Temperature (+)	TB11-3
Temperature (-)	TB11-7
Spare (+)	TB11-4
Spare (-)	TB11-8



CAUTION: MUST CONNECT TO AN ISOLATED INPUT TO AVOID GROUND LOOPS WHICH CAN DISRUPT THE MEASURING ELECTRODE.
DO NOT APPLY POWER TO THIS mA OUTPUT.

5.45 RS485 Serial Output Wiring

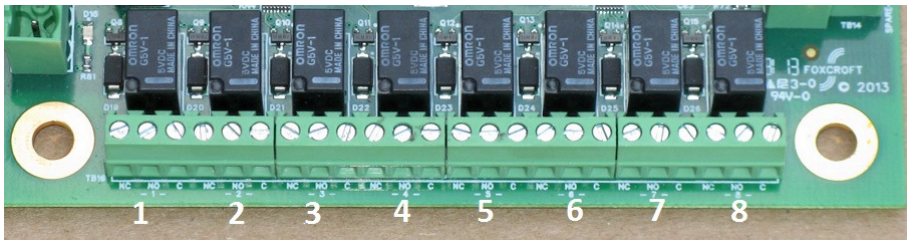
+	TB 1-1
-	TB 1-2



CAUTION: CONNECT TO ISOLATED INPUT

5.46 Wiring Form C 1A @ 24VDC (resistive) Alarm Relays, 30VDC max.

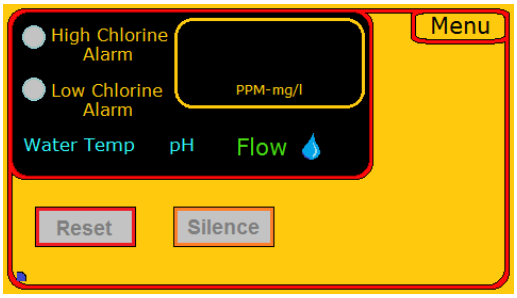
High Disinfectant - fixed/dedicated	Relay 1
Low Disinfectant - fixed/dedicated	Relay 2
No Flow - fixed/dedicated	Relay 3
Optional Relays Reserved Per Application	Relays 4 through 8



Section 6 Startup

1. Make sure the sample inlet ball valve is closed, the flow meter valve is closed and the drain valve is open. The pressure regulator is set to 15 PSI at the factory.
2. Turn on the analyzer by pressing the off/on rocker switch located on the bottom right underside surface of the analyzer enclosure.
3. The Foxcroft gray splash screen will appear as the software boots up,

followed by the Home operating screen.



On the circuit board the heartbeat indicator below the processor will be flashing red, and the “Power On” red LED indicator will light.

The screen will display the current sample residual and water temperature. If the pH measurement option is included the sample pH will also be displayed. The heartbeat indicator will flash in the lower left corner.

4. Slowly open the sample inlet ball valve to deliver sample to the system.
5. Make sure the water pressure gauge reading on the pressure reducing regulator is no more than atmospheric pressure, 15 psig. To adjust the pressure regulator:
    a. Loosen the check nut. Turn the adjusting screw clockwise to raise the reduced pressure, turn counter clockwise to lower the reduced pressure. Do not bottom out the adjusting screw.
6. With the water pressure reduced, slowly open the flow meter valve by turning the knob clockwise until a flow rate is at least 8 GPH. Flow may safely be set up to 12 GPH without affecting the chlorine sensor readings.
7. Make sure there are no pressure or flow fluctuations.

Startup (continued)

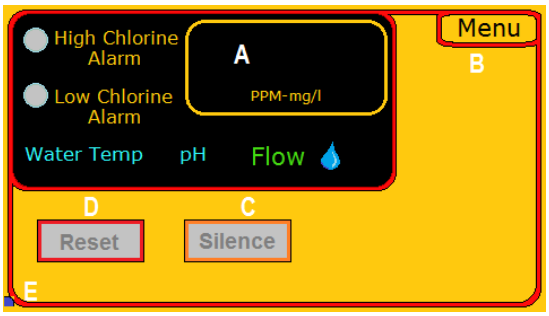
8. Allow the sensor to run for at least 1-2 hours (depending on sensor type) to become conditioned to the process. **Valid readings are not possible until the sensor has become conditioned.**
9. Calibrate the chlorine sensor span (standard) using the concentration determined by a grab sample analysis using an approved method. It is not necessary to perform a zero point calibration. See the Calibration section in this manual.
10. Allow the analyzer to operate for 24 hours and repeat the span calibration.

Section 7 Touch Screen Interface & Navigation

7.1 Main Screen Identification and Description

The main screen is both the home and run screen that will display automatically after the start up routine has completed and while the analyzer is in operation. Navigation through the menus is done simply by touching the item of interest.

You will find that lightly touching the screen with your finger works the best, ***do not use a pen or other hard object.*** You will hear a beep when a selection is made.



A	Non-interactive display of disinfectant concentration, water temperature, pH value if available, high and low disinfectant alarm status, flow status / no flow alarm
B	Active button to access setup menu items
C	Active button to silence disinfectant audible alarm if equipped
D	Active button to reset disinfectant alarm contacts
E	Flashing "heart beat" microprocessor status indicator

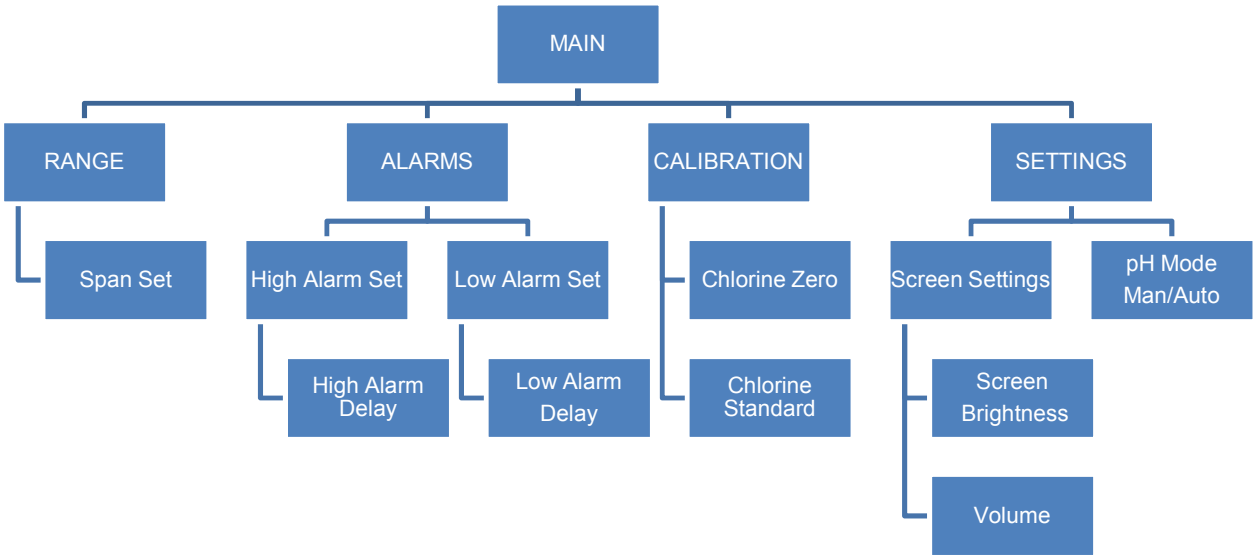
On the main screen white items with red borders are buttons that will actuate the indicated function by touching the screen. Items within the black field are displays only of live online measurements and alarm conditions. The large red values are the disinfectant concentration with unit of measurement below. If the residual exceeds the operating range only the maximum value of the range will be displayed.

The "High and Low Chlorine Alarm" indicators are blue if residual is within the alarm level settings. The indicators will turn red upon alarm condition and remain that color until the relay is reset by touching the RESET button. Touching the SILENCE button applies to an audible alarm if so equipped.

Normal flow status is indicated by Flow. This feature is deactivated in the reagentless sensor models. Upon no flow alarm condition relay contact #3 will close, the water drop image will be replaced by a flashing No Flow X. When flow is re-established the relay will reset (it cannot be reset manually) and flow status indicator will return to normal mode. The “No Flow” alarm is not adjustable.

The "heart beat" microprocessor status indicator flashes continuously every half second during normal operation. Upon processor failure the indicator will not flash at all, main board replacement is required.

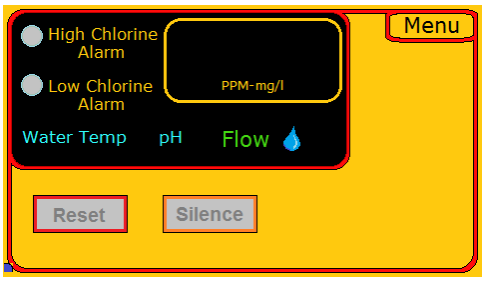
Section 7.2 Menu Structure



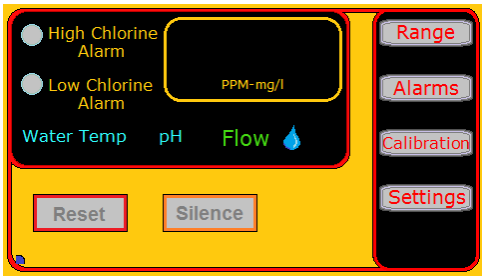
Section 5 Touch Screen Interface & Navigation

7.3 Screen Navigation

Navigation through the menus is done simply by touching the item of interest. After performing an adjustment you will return to the main home screen by touching menu. You will find that lightly tapping with your fingernail works the best. You will hear a beep when a selection is made.



Touching the Menu button will display the main submenus available to configure the analyzer. The software is designed to provide simple operation, therefore some functions and or capabilities are programmed at the factory and are not field adjustable.



RANGE SUBMENU: Displays and sets the operating range of the analyzer. Setting the range automatically scales the 4-20 mA output to the selected range and is not further scalable. Setting the range also automatically sets the high and low alarm set points to 10% and 90% of the range. The alarm trip points can be configured to other values.

ALARMS SUBMENU: Is used to set the high and low disinfectant alarm levels; and to set a time delay for each alarm before it will energize. Alarms are deactivated during calibration.

CALIBRATION SUBMENU: Is used to perform the zero point calibration if needed and span calibration to a grab sample or standard.

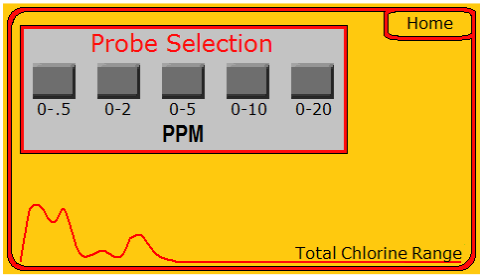
SETTINGS SUBMENU: These are used to adjust screen brightness and audio volume and to set pH compensation to manual or auto if this feature is available (for systems with pH sensor only). This screen also contains the serial number, the software version number, and display version number.

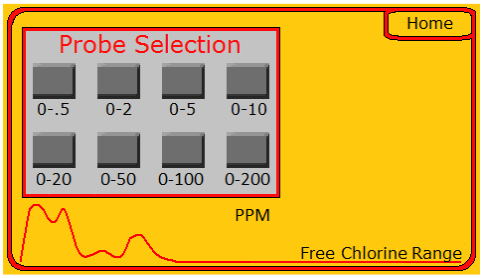
Section 7 Touch Screen Interface & Navigation

7.4 Configuring the Operating Range & mA Output

Setting the operating range will automatically set the mA output of the disinfectant residual to match the operating range, set the high alarm to 90% of span, and low alarm to 10% of span. The alarms can later be configured as needed. The range must match the operating range of the sensor. To change the operating range you must purchase a sensor with a different operating range.

1. From home menu, touch the RANGE button to display the operating range configuration screen that pertains to your sensor type.





2. Touch the button that matches the operating range of your sensor.
3. Touch the Home button to return to the home screen so that your selection takes effect. If needed reset the alarm levels from their default values.

.

5.5 Configuring the mA Output

CAUTION: the current inputs of any external device connected to the analyzer current output must be isolated to prevent ground loop interference with the measuring electrode. Do not apply power to this current output.

As stated above, in the standard software revision the mA output of the disinfectant residual is scaled automatically to match the operating range whenever the operating range is selected. The current output is accurate to within almost 1 micro amp, as such further scaling is not provided.

Additional current outputs, up to a total of four outputs, are available depending upon the options selected for the analyzer at the time of purchase.

Upon entering Calibration Mode the mA output is maintained at the last measured residual to prevent disruption to chlorine feed control by your SCADA, controller, PLC or metering pump.

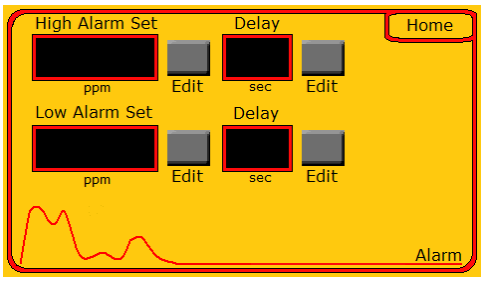
Section 7 Touch Screen Interface & Navigation

7.6 Configuring the Alarm Relays

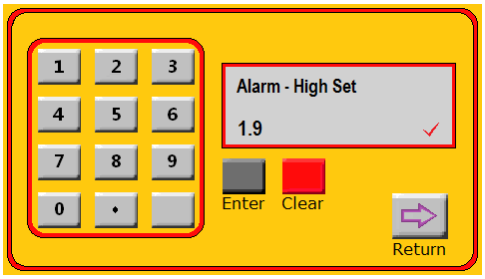
There are a total of (8) 1A dry contact form C relays each with LED indicator installed on the circuit board, only (3) are active in the standard configuration. Relay 1 is dedicated to the High disinfectant alarm, Relay 2 for the Low disinfectant alarm, and Relay 3 for the No Flow alarm. Upon a relay energizing its LED indicator will light. Each relay can be wired as either NO or NC; no software set up is needed to configure the relay as NO or NC.

Upon setting the operating range the High alarm trip point will be automatically set at 90% of the range, and the Low alarm trip point at 10% of range in order to provide a degree of protection in case the alarms are not set. The alarm trip points can be configured as needed.

1. Touch the Alarms button to display the high and low disinfectant alarm configuration screen. The alarms will be set by default to 10% and 90% of range upon setting the operating range.



2. To set the High residual alarm, touch the Edit button. On the High Alarm Set screen touch the Clear button, then use the keypad to enter the set point. A check mark will appear with the value entered, press Enter to select, press return to go back to the Alarms screen.



NOTE: If the high alarm is set above the upper limit of the operating range an “Out of Range” message will appear in the white box, and the high alarm set point will be forced to the upper limit of the operating range. Go back and enter a value no greater than the range limit.

CAUTION: If you need to change a setting at any time, you must first touch the Clear button AND enter a value AND touch the enter button to erase the previous value.

All values are stored in memory until they are cleared and replaced with another value. Failure to clear an existing number before entering a new number will produce invalid results. Touching “Clear” and the “Enter” alone will not clear the value in the register.

Section 7 Touch Screen Interface & Navigation

7.6 Configuring the Alarm Relays (cont.)

3. The “High Alarm Delay” is intended to prevent alarming during expected momentary deviations in residual levels. To set the delay in seconds first touch the Clear button, then use the keypad to enter the desired value and press the Enter key, a check mark will appear along with the selected value. The maximum value allowed is 300 seconds (5 minutes). Press Return to go back to the Alarms configuration screen.

4. To set the low disinfectant residual alarm repeat the process above using the Low Alarm Set “Edit” & “Delay” buttons.

5. Press Return to go back to the Alarms screen, then Menu to return to the main run screen.

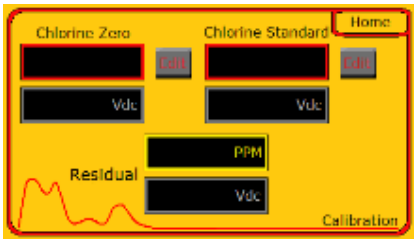
Section 7.7 Calibration

Calibration must be performed with an EPA or Standard Methods approved analytical method. The most accurate calibration method is amperometric titration. The DPD colorimetric method is also approved and is typically performed with portable hand held meters. Please note this method has a greater uncertainty than amperometric titration due to various interferences and inherent limitations of the method.

The accuracy of the FX-CL-F/T can never be greater than the instrument it is being calibrated against. Accuracy is a function of the method used, inherent tolerances in the calibration instrument, the quality and freshness of reagents, and the care taken to perform the calibration.

NOTE: Upon entering calibration mode the mA output will be maintained at the last measured residual to prevent disruption to chlorine feed control by your SCADA, controller, PLC or metering pump, and the alarm actuation will be deactivated. Live mA output and alarm states will ONLY resume after returning to the main run page.

On the Calibration page the top half of the screen shows the residual with associated cell voltages stored from the last calibration. The values in the center lower half of the screen are the live measured residual reading in ppm and the associated cell voltage. The cell voltage is provided as a troubleshooting tool. If the cell voltage and or residual appears to be too high at the zero point this could indicate that chlorine or some other oxidant is present, or that stray currents produced by other devices are being detected by the analyzer.



Section 7.7 Calibration

7.71 Setting the Zero Point.

A zero-point calibration is not required for the chlorine sensors included. If there is no chlorine present in the process medium, approximately zero is indicated. The zero point is independent of changes in the flow rate, conductivity, temperature and pH value.

If needed, the zero point can be re-set electrically. Simply turn on the analyzer with no water running and touch the calibration button from the home run screen. Touch the Chlorine Zero Edit button, on the keypad that appears press Clear, enter 0.00, then press Enter, and Return. Press the Home button to return to the Home screen so that newly entered values will take effect.

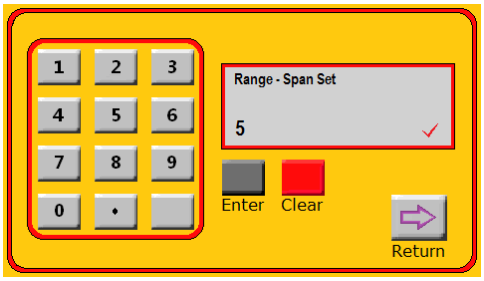
7.72 Calibrating the Span (Standard)

Stable chlorine standards do not exist; because of this the analyzer must be calibrated against a grab sample of the process fluid. Since chlorine residual is so unstable, take the grab sample as close to the measuring cell as possible and process the sample as quickly as possible.

NOTE: Always calibrate the span to at least 50% of the sensor range to avoid erratic measurements. For example, for a 0-100ppm sensor, calibrate at minimum 50ppm.

Do not interfere with the sample flow to the measuring cell when calibrating; always take the sample from the flow cell drain or sample tap.

If the value for the nominal slope is under 30%, the membrane cap and the electrolyte must be replaced and the electrode tip must be cleaned.



1. From the Calibration submenu screen touch the Chlorine Standard Set button. Press the Clear button, then enter the value determined by your grab sample instrument using the keypad and press Enter to both clear the previous standard and to enter the new value.

   A check mark will appear next to the value.

   > **NOTE:** If the standard value entered exceeds the upper limit of the operating range, an out of range message will appear in the white box and the value for the calibration standard will be forced to the operating range upper limit. Go back and re-enter the desired value.

   To enter a new calibration standard value you must first touch the Clear button AND enter a value AND touch the enter button to erase the previous value.

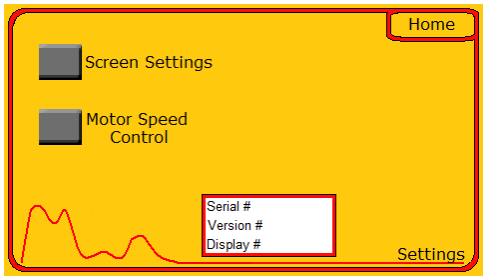
All values are stored in memory until they are cleared and replaced with another value. Failure to clear an existing number before entering a new number will produce invalid results. Touching “Clear” and the “Enter” alone will not clear the value in the register.

2. Press the Return button to go back to the Calibration submenu screen, and then press the Home button to return to the main Run screen so that newly entered values will take effect.

Section 7.8 Settings Submenu Screen

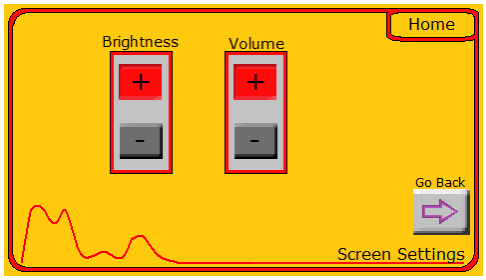
7.81Settings Screen

The settings screen allows you to adjust pump motor speed (on vinegar buffered systems only) as well as the screen brightness and audio volume. This screen also contains the serial number, the software version number, and display version number. These numbers are required for customer service and technical support.



7.82 Screen Settings

The screen brightness and audio volume can be adjusted to suit your needs. From the Settings submenu touch the “Screen Settings” button to display the adjustment screen.



Simply touch the Plus or Minus buttons to adjust as needed. Touch the “Go Back” button to return to the settings screen, or Home to return to the Home / Main run screen.

Section 8 Troubleshooting

Error/fault	Possible cause	Remedy	Preventive measures
Output signal of the sensor is too low or too high	Incorrect calibration	Repeat calibration according	Calibrate the sensor more frequently if required
Sensor output signal is too low. Sensor cannot be adjusted to the DPD value.	Settling time too short.	Wait at least 2 hours	
	Deposit on the tip of the electrode finger (measuring electrode)	Clean tip of electrode finger.	If necessary shorten maintenance intervals.
	Inflow to the measuring cell is too low	Increase incident flow.	Monitor minimum incident flow.
Output signal of the sensor is too low Sensor cannot be calibrated to the DPD value Output signal of the sensor decreases or stays the same when the DPD value is increased Fluctuating signal	Membrane destroyed: Electrolyte escaping-process medium entering.	Replace membrane cap.	Avoid damaging the membrane. Do not knock the sensor when the membrane cap is screwed on. Avoid incident flow containing coarse particles
	Coating on the membrane cap.	Replace membrane cap.	
	Gas bubbles on the outside of the membrane.	Increase the flow briefly.	Check mounting and change if necessary.
	No electrolyte in the membrane cap	Fill the membrane cap with electrolyte, See "Filling membrane cap with electrolyte"	
Sensor output signal is too high. Sensor cannot be adjusted to the DPD value.	In addition to the analyte, the process medium also contains other oxidizing agents, for example ClO_2, O_3	Avoid adding these substances. Change the water.	Remove cleaning agents and Disinfectants completely after use.
(5) The DPD and sensor values match and the trend of the redox measurement is correct, but the set point value is not maintained.	incorrect control parameters.	Optimize the control parameters.	
	The amount of disinfectant dosed per unit of time is too high. Concentration is exceeded before the process medium reaches the sensor.	Reduce the amount added per unit of time. Reduce the concentration of disinfectant in the solution added.	
Sensor and DPD values do not correspond to each other, the sensor values fluctuate	System circulation is too slow. Incorrect control parameters	Improve mixing. Optimize control parameters	Make structural changes to ensure more thorough mixing.

Section 8 Troubleshooting

Error/fault	Possible cause	Remedy	Preventive measures
Sensor is unusually slow in responding	The membrane is partially blocked by pollutants such as calcium or oil. Disinfectant is prevented from reaching the sensor	Replace membrane cap.	Take steps to improve the water quality.
Output signal of the sensor is "0"	The sensor has been connected to the analyzer with reverse polarity	Connect the sensor correctly	
	The measuring cable is broken	Replace the measuring cable	
	The sensor is faulty	Return to mfr.	
	Analyzer is faulty	Return to mfr.	
Display is blank	Display failure Main circuit board failure	If main card heartbeat is flashing replace display. If main card heartbeat is not flashing replace card. Replace display if still blank with new card installed.	

8.1 Specific Troubleshooting Of The Sensor

If the electrode finger has a bright silvery or white appearance, the sensor must be reconditioned by the manufacturer. Brown-gray colors are normal.

8.11Testing the leak-tightness of the membrane cap

1. Carefully dry the outside of the membrane cap to be checked.
2. Prepare the membrane cap for mounting and fill it with electrolyte (2-electrode sensor caps may use clean water for this test).
3. If necessary, dry the outside of the membrane cap again.
4. Slowly and carefully screw the membrane cap onto the sensor shaft.
5. When screwing the membrane cap on, check if the gel leaks through the membrane.
6. Check carefully to determine that liquid does not leak through the membrane but that it escapes at the vent hole designed for this purpose.

If droplets form on the membrane, the membrane is faulty and you must use a new membrane cap. The formation of a small meniscus is acceptable as the membrane has hydrophilic properties.

If the membrane cap is not leak-proof, you must check if the reference electrode was damaged when the measuring water and electrolyte were replaced. If the electrode finger has a bright silvery or white appearance, the measuring cell must be sent to the manufacturer for inspection.

Section 8.1 Specific troubleshooting on the sensor

8.12 Testing the sensor electronics (dry run)

1. Unscrew the membrane cap per procedures.
2. Carefully rinse the electrode finger and dry it carefully with a clean cloth.
3. Connect the sensor to the indicator/controller and wait for approx. 5 minutes.
4. Read the signal from the cell on the analyzer or measure it with a digital multimeter.

The measured value should be approx. 4 mA.

– If the sensor signal corresponds to roughly this value, the electronics are likely to be working correctly.

– If the measured value is significantly different from the value stated above, the sensor must be sent to the manufacturer for inspection.

8.13 Testing the zero point

The zero point should be tested after the electronics have been tested.

1. Prepare the sensor for startup.

2. Connect the sensor to the analyzer.

3. Carefully place the sensor in a beaker with clean tap water (without disinfectant).

4. Move the sensor around in the beaker for approx. 30 s (without creating air bubbles).

5. Leave the sensor in the beaker for > 1 hour and wait for the settling time to elapse.

6. Read the signal from the cell on the analyzer or measure it with a digital multimeter.

7. The sensor signal should be around the zero point.

– If the signal from the measuring cells has a value of around zero, the zero point is likely to be working.

– If the measured value deviates significantly from zero, maintenance must be carried out on the sensor and the "zero point test" must be repeated. You must bear in mind that a working electrode which has just been cleaned has a relatively high zero point.

In this case, the measuring cells will take a few days to reach their lowest zero point.

– If the measured value is not around zero, even after maintenance has been carried out, the sensor

must be sent to the manufacturer for inspection.

NOTE
In general, the zero points of sensors with an extremely small measuring range or which are more sensitive are slightly higher than for measuring cells with large measuring ranges or which are less sensitive.

Section 9 Maintenance

The FX-CL-F/T analyzer is designed to operate continuously, 24 hours a day, 365 days a year. The system requires little routine maintenance other than changing the sensor electrolyte at prescribed intervals and mandated calibration checks.

However, regular maintenance should be performed to ensure optimum performance and accuracy. Maintenance frequency required varies by water quality and the residual maintained.

The maintenance schedule below is recommended. Some applications may require more cell maintenance due to high levels of suspended solids, high calcium levels, or other characteristics of the sample liquid.

9.1 Maintenance Schedule

	Potable Water	*Waste Water*	
Visual & Flow Inspection	Once per week	Once per week	
Verify Calibration	Once per week	Once per week	
Clean Sample Flow Cell	As needed	As needed or weekly	

1. Visually check for leaks.
2. Visually check for dirt or deposits in the flow cell, clean if needed.
3. Perform calibration checks per regulations
4. Change the electrolyte every 3-6 months depending on water quality.
5. Replace the membrane cap once per year.

Section 10 Parts List

Description	Part No.
Touch Screen Display	400001
Display Cable	400002
Circuit Board	400003
Power Supply	400004
Power Cable	400005
6A fuse, power entry module	400008
Flow cell, single sensor	303500
Wall mount bracket, Stainless Steel, for single sensor flow cell	303515
Additional tubing flexible PVC, per foot	303526
O-ring, inspection glass (item 5)	303501
O-ring, stepped collar (item 10)	303502
FLOWMETER, 0.5-12 GPH Water; 4-in Scale	303552
Membrane cap 2-electrode Free chlorine, with emery cloth	303200
Membrane cap 3-electrode Free chlorine reduced pH dependence, with tip holder, emery cloth	303201
Membrane cap, Total Chlorine, with emery cloth	303220
Electrolyte for 2-electrode Free chlorine, 100 ML	303300
Electrolyte for 3-electrode Free chlorine reduced ph dependence, 100 ML	303301
Electrolyte for Total Chlorine, 100 ML	303320
Sensor Free chlorine, 2-electrode, 0-0.5 mg/l (ppm)	301200
Sensor Free chlorine, 2-electrode, 0-2 mg/l (ppm)	301201
Sensor Free chlorine, 2-electrode, 0-5 mg/l (ppm)	301202
Sensor Free chlorine, 2-electrode, 0-10 mg/l (ppm)	301203
Sensor Free chlorine, 3-electrode, 0-2 mg/l (ppm)	301251
Sensor Free chlorine, 3-electrode, 0-5 mg/l (ppm)	301252
Sensor Free chlorine, 3-electrode, 0-10 mg/l (ppm)	301253
Total chlorine, 3-electrode, 0-0.5 mg/l	301300
Total chlorine, 3-electrode, 0-2.0 mg/l	301301
Total chlorine, 3-electrode, 0-5.0 mg/l	301302
Total chlorine, 3-electrode, 0-10.0 mg/l	301303
Total chlorine, 3-electrode, 0-20.0 mg/l	301304
NOTE: the vent seal is not available as a separate part, it is only available with a new membrane cap	

Section 11 Service Contact, Return Policy

Customer Service Department

If you need spare parts, assistance in troubleshooting, or repair service, please contact Foxcroft Customer Service at:

Foxcroft Equipment and Service, Co. Inc.
2101 Creek Road, P.O. Box 39
Glenmoore, PA 19343

Tel: (800) 874-0590
(610) 942-2888
Fax: (610) 942-2769
Email: service@foxcroft.com
Website: www.foxcroft.com

Customer Repair / Returns Policy

All systems returned for repair or replacement must be freight prepaid and include the following information:

1. A clearly written description of the malfunction.
2. Name of person to contact and the phone number where they can be reached.
3. Proper return address for shipping system back. Include preferred shipping method.
4. A purchase order if the system is out of warranty to cover costs of repair.
5. A Return Material Authorization Number (RMA) is required before shipping any products for service. Call telephone number above to receive a RMA number.

NOTE: *Returns will only be held at Foxcroft for 90 days. If a decision is not made regarding the repair, the product will be returned.*

Section 12 Product Warranty

Foxcroft Equipment & Service warrants all products obtained hereunder to be free from defects in material and workmanship for a period of one year from the date of shipment. In the event of a product failure or defect requiring warranty repair, the customer must obtain an RMA number by calling 1-800- 874-0590, before returning the product, at the customer's expense to Foxcroft for repair. Warrantor (Foxcroft Equipment and Service) will repair the unit, without charges for parts, labor and return freight.

Foxcroft Equipment & Service is not responsible for damage to its products through improper installation, maintenance, act of God, use or attempts to operate such products beyond their functional capacity, intentionally or otherwise, or for any unauthorized repair.

Buyer agrees to hold Foxcroft Equipment & Service harmless from all claims for damages arising out of injury or death to any person or damage to any facility, or any other property, or loss of use of any such property, whether such person or property is on or off the installation or activity site for which the equipment or material furnished hereunder is destined and whether such damage, loss destruction or loss of use, injury or death results directly or indirectly from a nuclear incident or for any other cause.

Statements and instructions set forth herein are based upon the best information and practices known to Foxcroft Equipment & Service but it should be assumed that every acceptable safety procedure is contained herein. Of necessity this company cannot guarantee that actions in accordance with such statements and instructions will result in the complete elimination of hazards and it assumes no liability for accidents that may occur.

FOXCROFT

EQUIPMENT & SERVICE COMPANY, INCORPORATED

Serial Number Label for FX-CL
Amperometric Chlorine Residual Analyzer

Foxcroft Equipment & Service Co. Inc.

2101 Creek Road, P.O. Box 39

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