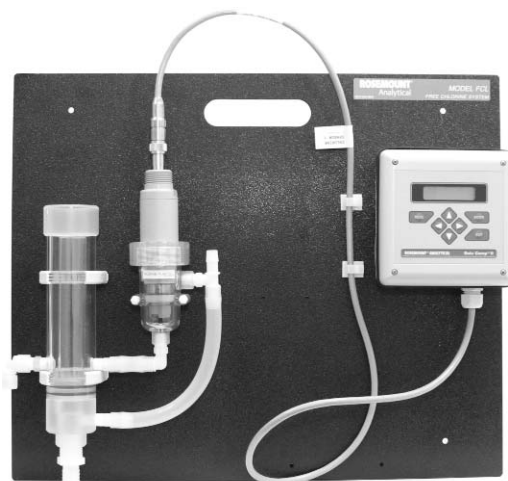


Free Chlorine Measuring System

- COMPLETE SYSTEM INCLUDES sensor, connecting cable, analyzer, and flow controller
- SENSOR RESPONSE IS PRACTICALLY INDEPENDENT of pH between pH 6.5 and 10
- NO REAGENTS
- NO AUXILIARY pH ELECTRODE
- VARIOPOL QUICK-DISCONNECT FITTINGS makes sensor replacement easy



APPLICATIONS AND FEATURES

The Model FCLi free chlorine system is intended for the determination of free chlorine (hypochlorous acid plus hypochlorite ion) in fresh water. Unlike free chlorine analyzers from other manufacturers, the Model FCLi does not use expensive sample conditioning systems or messy reagents to control pH. Nor, does it require an auxiliary pH sensor for pH correction. Instead, the pH adjustment takes place inside the sensor, producing a signal that changes less than 4% per unit change in pH between pH 6.5 and 10. Below pH 6.5 the change is less than 1%. The linear range of the sensor is 0 to 20 ppm (mg/L).

The Model FCLi is not intended for the determination of total or combined chlorine (like monochloramine). Nor, can the FCLi be used for the determination of chlorine in seawater.

The Model FCLi uses a three electrode, membrane-covered amperometric sensor. The sensor consists of a hydrophilic membrane stretched over a gold mesh cathode. A silver/silver chloride reference electrode and an external copper auxiliary electrode complete the circuit. The fill solution is saturated succinic acid slurry. During operation, an electrochemical reaction, driven by the polarizing voltage, consumes free chlorine at the cathode surface. The auxiliary electrode provides the electrons for the cathode reaction, and a current proportional to the reaction rate flows between the electrodes. Because the concentration of chlorine at the cathode is zero, free chlorine in the sample continuously diffuses through the membrane and is destroyed at the cathode. Thus, the cathode current is proportional to the diffusion rate, which is proportional to the concentration of free chlorine in the sample.

Unlike other free chlorine sensors, the FCLi sensor requires neither sample pretreatment nor pH correction. All amperometric free chlorine sensors generate a raw current that depends primarily on the concentration of hypochlorous acid. Because the fraction of free chlorine present as

hypochlorous acid is a function of pH, readings will be in error if the sample pH changes from the value it had during calibration. To correct for pH changes, some manufacturers treat the sample with acid to convert hypochlorite to hypochlorous acid. Others continuously measure the pH and use the pH value to correct the chlorine sensor reading. The Model FCLi is different. The sensor uses a highly buffered acidic fill solution for internal pH adjustment. The fill solution converts all the free chlorine entering the sensor as well as much of the free chlorine at the outside surface of the membrane into hypochlorous acid. Thus, the sensor response is practically independent of pH.

For customers who wish to measure pH, an option that includes a pH sensor and flow cell is available.

Maintenance is fast and easy. Replacing a membrane requires no special tools or fixtures. A screw cap holds the pre-tensioned membrane in place. Replacing the membrane and fill slurry takes only a few minutes.

The Model FCLi includes the easy-to-use Model 1055 analyzer. The analyzer features two fully programmable 4-20 mA analog outputs and three fully programmable alarm relays. Programming and calibration is simple and intuitive. The backlit, two-line display allows the user to read chlorine (and pH) at a single glance.

Valves, rotameters, and pressure regulators to control sample flow are things of the past with the the Model FCLi. A constant head overflow sampler ensures the correct flow to the sensor no matter how much the sample flow or pressure changes. To eliminate wiring hassles, quick disconnect Variopol cable is standard.

Stable free chlorine standards do not exist. The chlorine sensor must be calibrated using the results of a laboratory test on a grab sample.

SPECIFICATIONS — GENERAL

Sample requirements:

Pressure: 3 to 65 psig (122 to 549 kPa abs)

A check valve in the inlet prevents the sensor flow cells from going dry if sample flow is lost. The check valve opens at 3 psig (122 kPa abs). If the check valve is removed, minimum pressure is 1 psig (108 kPa abs).

Temperature: 32 to 122°F (0 to 50°)

Minimum Flow: 2 gal/hr (7.6 L/hr)

Maximum flow: 80 gal/hr (303 L/hr); high flow causes the overflow tube to back up.

Sample Conductivity: >10 µS/cm

Process connection: 1/4-in OD tubing compression fitting (can be removed and replaced with barbed fitting for soft tubing).

Drain connection: 3/4-in barbed fitting. Sample must drain to open atmosphere.

Wetted parts:

Overflow sampler: acrylic, polycarbonate, polyester, Kynar¹, nylon, silicone

Chlorine sensor: PVC, Viton², silicone, polyether-sulfone, polyester, and copper

pH sensor: Tefzel², Viton, glass, ceramic

Response time to step change in chlorine concentration: <120 sec to 90% of final reading for inlet sample flow of 2 gph (7.6 L/hr).

Weight/shipping weight:

Model FCLi-01: 10 lb/13 lb (4.5 kg/6.0 kg)

Model FCLi-02: 11 lb/14 lb (5.0 kg/6.5 kg)

[rounded to the nearest 1 lb. (0.5 kg)]

SPECIFICATIONS — SENSOR

Free chlorine range: 0 to 20 ppm as Cl₂. For higher ranges, consult the factory.

Accuracy: Accuracy depends on the accuracy of the chemical test used to calibrate the sensor

Linearity (0-20 ppm): 1% per IEC 60746

Linearity (0-2 ppm): ±0.05 ppm following calibration at 2 ppm

Sensitivity to pH: Between pH 6.5 and 10, sensor signal changes <4% per unit change in pH. Below pH 6.5 the change is <1% per unit change in pH.

Interferences: Monochloramine, dichloramine, and permanganate

Electrolyte life: 3 months (approx.)

SPECIFICATIONS — ANALYZER

Case: Polycarbonate, NEMA 4X/CSA4 (IP65)

Display: Two-line, 16-character, back-lit. Character height: 4.8 mm.

Languages: English, German, Italian, Spanish, French, Portuguese

Ambient temperature and humidity: 0 to 50°C (32 to 122°F); RH 5 to 95% (con-condensing)

The analyzer can be operated between -20 and 60°C (-4 to 140°F) with some degradation in display performance.

☐ **Power:** 115/230Vac ± 15%, 50/60 Hz ± 6%, 8.0 W. Installation category II.

Ordinary Location:



12RN

POLLUTION DEGREE 2: Normally only non-conductive pollution occurs. Occasionally, however, a temporary conductivity caused by condensation must be expected.

Equipment protected throughout by double insulation.



RFI/EMI: EN-61326

LVD: EN-61010-1

Outputs: Two 4-20 mA or 0-20 mA isolated outputs. Continuously adjustable. Linear or logarithmic. Maximum load 500 ohms. Output dampening with time constant of 5 sec is user-selectable.



Alarms: Three alarm relays for process measurement(s) or temperature. Alarm 3 can be configured as a fault alarm instead of a process alarm. Each relay can be configured



	Resistive	Inductive
28 Vdc	5.0 A	3.0 A
115 Vac	5.0 A	3.0 A
230 Vac	5.0 A	1.5 A

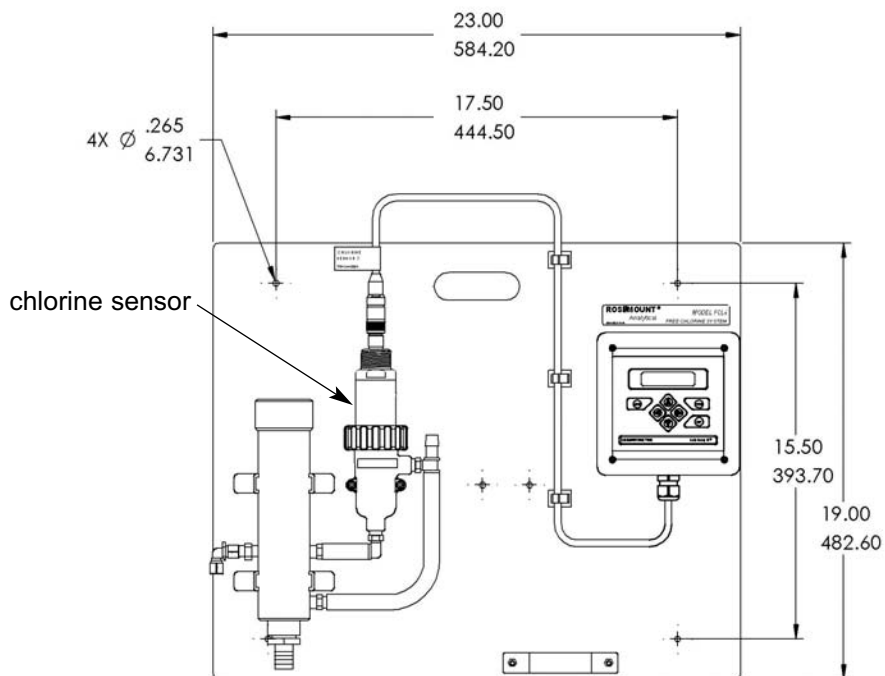
independently. Alarm logic (high or low activation) and deadband are user-programmable.

Relays: Form C, single pole double throw, epoxy sealed

¹ Kynar is a registered trademark of Elf Atochem North America.

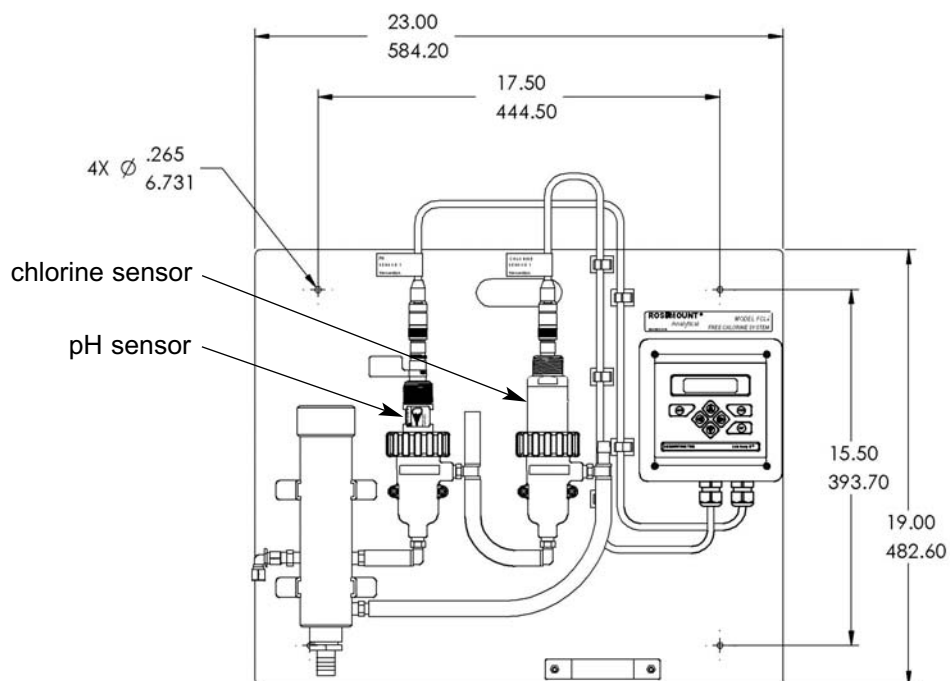
² Viton and Tefzel are registered trademarks of DuPont Performance Eastomers.

WHEN INCH AND METRIC DIMS
ARE GIVEN
INCH
MILLIMETER



Model FCLi-01

WHEN INCH AND METRIC DIMS
ARE GIVEN
INCH
MILLIMETER



Model FCLi-02

ORDERING INFORMATION

Model FCLi Free Chlorine Measuring System. The FCLi is a complete system for the determination of free chlorine in aqueous samples. It consists of the sensor(s), analyzer, and constant head flow controller. All components are mounted on a backplate. Model option -02 includes a pH sensor for customers who wish to measure pH in addition to free chlorine. Three replacement membranes and enough electrolyte chemicals to fill the sensor three times are shipped with each sensor.

MODEL FCLi FREE CHLORINE MEASURING SYSTEM	
CODE	pH CORRECTION (required selection)
01	Without pH sensor
02	With pH sensor
FCLi-02 EXAMPLE	

COMPONENT PARTS

ANALYZER MODEL	DESCRIPTION
1055-01-11-24-68	1055 analyzer, single input (chlorine), wall mount, 115/230 Vac
1055-01-11-24-32-68	1055 analyzer, dual input (chlorine and pH), wall mount, 115/230 Vac

SENSOR MODEL	DESCRIPTION
499ACL-01-54-VP	pH-independent free chlorine sensor with Variopol connector
399VP-09	pH sensor with Variopol connector

SENSOR CABLE	DESCRIPTION
24150-00	Interconnecting cable, Variopol for 498ACL sensor, 4 ft
23645-08	Interconnecting cable, Variopol for 399VP sensor, 4 ft

ACCESSORIES

PART #	DESCRIPTION
9240048-00	Tag, stainless steel (specify marking)

SPARE PARTS

PART #	DESCRIPTION
33970-00	Fill plug
33968-00	Membrane retainer
9550094	O-ring, 2-014, Viton®
23501-10	pH-independent free chlorine membrane assembly, includes one membrane assembly and O-ring
23502-10	pH-independent free chlorine membrane assembly, includes three membrane assemblies and three O-rings
24146-00	pH-independent free chlorine sensor electrolyte kit, includes three bottles of saturated succinic acid and three bottles of succinic acid crystals

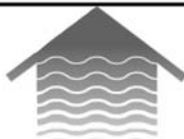
MODEL FCLi ENGINEERING SPECIFICATION

1. The system shall be suitable for the determination of free chlorine in water without sample conditioning reagents or an auxiliary pH sensor. Systems that use sample conditioning or require a pH sensor for pH-correction are not acceptable.
2. The system shall consist of an analyzer, a free chlorine sensor, flow cell for the sensor, and a flow controller. The components shall be mounted on a back plate. Sensor cable shall be pre-wired to the analyzer. The sensor shall plug into the cable using a Variopol quick disconnect fitting. The flow cell shall be clear plastic to allow the sensor to be easily inspected for fouling. The inlet shall be fitted with a check valve to ensure the sensor remains wet in the event sample flow is lost.
3. Although a pH measurement is not required for correcting the raw chlorine signal, a system incorporating a pH sensor shall be available as an option.
4. The system shall use no mechanical devices, such as pressure regulators, valves, or rotameters, to control flow. Instead, flow shall be regulated using a constant head flow controller. Minimum sample flow shall be no more than about 3 gallons per hour (11 liters per hour). Maximum flow can be as high as 80 gallons per hour (303 liters per hour). The flow controller shall be able to handle inlet pressure between 3 and 65 psig (122 to 549 kPa abs) and temperature between 32 and 122°F (0 and 50°C).
5. The free chlorine sensor shall be a three-electrode membrane-covered sensor with a silver/silver chloride reference, gold mesh cathode, and external copper auxiliary electrode. The fill solution shall be saturated succinic acid. The free chlorine sensor shall be fitted with an RTD to allow continuous correction for changes in membrane permeability caused by temperature.
6. The change in chlorine signal shall be less than 4% per unit change in pH between pH 6.5 and 10.
7. The linear range of the free chlorine sensor shall be at least 0 to 20 ppm as Cl₂.
8. The linearity between 0 and 20 ppm shall be 1% (IEC 60746).
9. The optional pH sensor shall be a combination electrode having a glass sensing membrane and a double junction reference electrode.
10. The analyzer shall have dual input, one for the free chlorine sensor and the other for the optional pH sensor. The analyzer shall receive the raw signal from the free chlorine sensor and automatically correct it for temperature effects. Results shall be displayed as ppm Cl₂.
11. The analyzer shall require single point calibration if the expected chlorine level is within the linear range of the sensor. For high concentrations, where the sensor response is slightly non-linear, a dual slope calibration shall be available. A correction for the sensor zero current shall also be available.
12. The analyzer shall have automatic buffer recognition for pH sensor calibration.
13. The analyzer shall have a two line, back lit display. The display shall show ppm chlorine, pH (if measured), and temperature in one screen. The user shall be able to choose other screens to display additional information such as raw sensor current.
14. The analyzer shall be capable of operating between 32 and 122°F (0 and 50°C) and between 5 and 95% relative humidity (non-condensing).
15. The analyzer shall have dual 0/4-20 mA isolated outputs. Outputs shall be fully scalable and assignable independently to chlorine, pH (if measured), or temperature.
16. The analyzer shall have three alarm relays fully programmable for logic (high or low operation), dead band, and set point. One alarm shall be configurable as a fault alarm.
17. All analyzer programming shall be through a front panel membrane keypad. The language (English, Spanish, Italian, Portuguese, German, or French) used in the menu screens shall be selectable by the user.
18. The analyzer shall have a security feature to prevent unauthorized tampering with calibration and configuration settings.
19. The analyzer shall be Rosemount Analytical Model FCLi-01 (free chlorine only) or Model FCLi-02 (free chlorine with optional pH sensor) or approved equal.



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